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**South-Eastern Agricultural College**

**WYE, KENT**

*Edited for the College by*

S. GRAHAM BRADE-BIRKS, M.Sc. (Manc.), D.Sc. (Lond.), F.Z.S.

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## EDITORIAL

It is many years since more than one issue of the *Journal of the South-Eastern Agricultural College* has been made in the same Session. It has now been decided to publish a number in January to give an account of some of the activities of the College during the previous Session and then later in the year, in July, to produce another number devoted mainly to the publication of original papers. For convenience these may be designated: the January issue, *The Report* number; the July issue, *The Research* number.

Once again we are indebted to Mr. W. M. Ware for preparing an index to this number of the *Journal*.

S. GRAHAM BRADE-BIRKS.

## CONTENTS

	Page
DEPARTMENT OF ENTOMOLOGY. By S. G. Jary and M. D. Austin .. ..	7
MYCOLOGICAL DEPARTMENT. By Prof. E. S. Salmon and W. M. Ware .. ..	15
HOPS. By Prof. E. S. Salmon .. .. .	23
HOP RESEARCH SCHEME. HOP EXPERIMENTS—WYE FIELD. By A. H. Burgess	25
CHEMISTRY DEPARTMENT. By W. Goodwin, M.Sc., Ph.D. .. .. .	27
THE CHEMISTRY OF INSECTICIDES AND FUNGICIDES. By H. Martin, M.Sc., A.R.C.Sc., F.I.C. .. .. .	31
DEPARTMENT OF ECONOMICS. By James Wyllie .. .. .	35
VETERINARY DEPARTMENT. By A. D. McEwen .. .. .	38
DAIRY BACTERIOLOGICAL ADVISORY SERVICE. By H. Barkworth .. ..	42
AGRICULTURAL DEPARTMENT. By V. R. S. Vickers, V. C. Fishwick, H. B. Bescoby and N. L. Tinley .. .. .	46
BOTANICAL DEPARTMENT. By S. T. Parkinson, R. T. Pearl and R. M. Harrison	53
ENGINEERING DEPARTMENT. By Cornelius Davies .. .. .	55
DEPARTMENT OF ZOOLOGY AND GEOLOGY. By S. G. Brade-Birks and Basil S. Furneaux .. .. .	60

## DEPARTMENT OF ENTOMOLOGY

S. G. JARY and M. D. AUSTIN.

THE writer, on appointment to the post of Advisory and Research Entomologist, took up duties on January 22nd, 1931, from which time this report therefore dates. Prior to that date the Department was under the charge of Mr. C. A. W. Duffield. The process of becoming familiar with the Province has, of necessity, occupied a good deal of time during the year, and the writer desires to thank the other Advisory Departments for a great deal of assistance in this respect ; he is also particularly indebted to Mr. M. D. Austin.

## ENQUIRIES AND ADVISORY WORK.

CEREALS. Very few pests of Cereals have been recorded as prevalent, with the exception of Leather Jackets (*Tipula* spp.) which have been widespread. Frit-fly (*Oscinis frit*) and Gout Fly (*Chlorops taeniopus*) on Spring Oats and Barley respectively, appear to have been scarce.

POTATOES. Many instances of partial loss of crops due to Potato sickness, involving the Potato Eelworm (*Heterodera schachtii*) have been reported. These have occurred mainly in Surrey and Sussex, garden and allotment crops being chiefly concerned. Slugs have caused damage to tubers in most places and isolated cases of attack by the Stem Borer (*Hydroecia micacea*) have been seen.

PULSE AND CLOVERS. The Black Aphis (*Aphis rumicis*) was common on most crops of Beans but the attacks did not become severe. Peas, especially main and late crops, were damaged by Thrips (*Frankliniella robusta*), both in the field and garden. Pea and Bean Weevils (*Sitona* spp.) were abundant but not unduly destructive, probably owing to the absence of any periods of drought. Material of this damage was supplied on request, to the Plant Pathological Laboratories of the Ministry of Agriculture, Harpenden.

MANGOLDS AND BEET. Slight infestations by the Black Aphis (*Aphis rumicis*) were common, but no harm was done. The Mangold Fly (*Pegomya betae*) was also very scarce. A few serious attacks by the Pigmy Mangold Beetle (*Atomaria linearis*) occurred, resulting in two successive sowings being destroyed on one farm. An instance of the value of preventive measures occurred in connection with a field about to be sown with mangolds, which was found to be swarming with Leather Jackets. The field was treated with a Paris Green and Bran poison bait and great numbers of dead Leather Jackets were afterwards found. The mangolds were then sown and no damage whatever was done to them.

BRASSICAE. In spite of a wet season, Flea Beetles (*Phyllotreta* spp. and *Plectroscelis concinna*) were abundant. Many seed-beds of garden brassicae were ruined early in the year. Field crops sown later were little harmed, but in August severe attacks on Coleworts developed in the Rochester area. Many acres there were completely destroyed

and resowing was common. The species concerned in the late attacks were *Phyllotreta cruciferae*, *Phyllotreta consobrina*, *Plectroscelis concinna* and *Psylliodes chrysocephala*. The cabbage White Butterflies (*Pieris* spp.) were never abundant and the Cabbage Root Fly (*Chortophila brassicae*) was also of little consequence.

OTHER VEGETABLES. Celery Fly (*Acidia heraclei*) and Carrot Fly (*Psila rosae*) have been only moderately common and have caused very little damage. One instance of the destruction of a crop of Parsnips by a root feeding aphid (*Anuraphis subterranea*) was seen.

GLASSHOUSE PLANTS. Especially in the Worthing area, Beans have suffered from attacks by Thrips, and the Tomato Moth (*Hadena oleracea*) also occurred. The Root Knot Eelworm (*Heterodera radiculicola*) was recorded particularly on Tomatoes and Cyclamen. Mushrooms have been the subject of many enquiries. Attacks involving various Mites, Flies (*Sciara* and *Drosophila* spp.) and Collembola (Springtails) have been seen. Thanks are due to Mr. A. M. Massee of the East Malling Research Station for identifying some of the Mites. The Woolly Vine scale was recorded from Ramsgate.

FRUIT. Capsid Bugs (*Plesiocoris rugicollis* and *Lygus pabulinus*) on Apples and Currants have been common and destructive. The year has been notable for the extreme abundance of the Apple Blossom Weevil (*Anthonomus pomorum*), which in some places destroyed over 75 per cent. of the blossom. The Apple Bud Weevil (*Anthonomus cinctus*) has also been found in several orchards, in one case destroying a large number of the fruit buds. Apple Sawfly attacks have also been severe and resulted in a great loss of fruit. Aphides, although not generally prevalent, were present to some extent, especially where Tar Oils had been omitted from Winter Washes in favour of Petroleum Oils. The Rosy Apple Aphis (*Anuraphis roseus*) has been the most common species. The Leaf Curling Plum Aphis (*Anuraphis padī*) and the Apple Sucker (*Psylla mali*) were present generally where Tar Oil washing was not done. The Currant and Gooseberry Aphides (*Aphis grossulariae*, *Amphorophora cosmopolitana* and *Capitophorus ribis*) were not abundant. A second brood of the Codlin Moth (*Cydia pomonella*) did some damage to Apples and appears to be increasing in numbers. The Fruit Tree Red Spider (*Oligonychus ulmi*), normally only severe in dry seasons, was unexpectedly abundant, occurring on both Apples and Pears in Kent and East Sussex. Raspberries and Loganberries suffered heavy attacks from the beetle *Byturus tomentosus*, rendering much fruit unfit for market. Cultivated Blackberries at Wye were also attacked. Many enquiries regarding methods of control for this pest were received. Winter Moth caterpillars, though not so prevalent as in some seasons, were sufficiently common in places to cause damage. In East Sussex, the Strawberry Blossom Weevil (*Anthonomus rubi*) was plentiful. Upwards of 50 per cent. of the buds was destroyed in a field near Chailey and bad attacks occurred in other places also. Raspberries and cultivated Blackberries were attacked, and the insect was discovered to be breeding on various weeds. The Strawberry Mite (*Tarsonemus fragariae*) appears to be widespread in the Province. Some loss of plants was caused among Strawberries by the larvæ of the Cockchafer (*Melolontha vulgaris*), Weevils (*Otiorrhynchus* spp.) and the Swift Moth (*Hepialus lupulinus*). Together with these, the larvæ of a Crane Fly (*Pachyrrhina* spp.) commonly occurred. The Woolly Aphis (*Eriosoma lanigerum*) did not appear on Apples until late in the summer and was generally below normal in severity. The Twig Cutter (*Rhynchites coerulesus*) was noted in Kent and Sussex. Wasps (*Vespa* spp.) have not been common and Earwigs (*Forficula auricularia*) also less injurious than usual.

HOPS. The Hop-Damson Aphis (*Phorodon humuli*) has been persistent, and attacks by Capsid Bugs (*Calocoris norvegicus* and *Lygus pabulinus*) have also been observed. Some injury to Hop foliage, which appears after Bordeaux spraying, has been investigated and it seems that this injury may be caused by penetration of Copper in the Bordeaux, through punctures made by Aphides and Capsids. An examination of material of this nature was made in conjunction with the Mycological Department.

FLOWERS. Attacks by a fly (*Hylemyia brunnescens*) on Carnations has been noted in Sussex. Several cases of severe damage to Roses were seen, due to the Large Rose Sawfly (*Hylotoma rosae*). Specimens of this insect were sent in by the National Rose Society for identification.

MISCELLANEOUS. Ants infesting houses have been the subject of some enquiries. Specimens of various insects have been received for identification. A caterpillar, said to have been found in a previously unopened box of a proprietary cereal food, was received. This was bred out and proved to be the larva of the Cabbage Moth (*Mamestra brassicae*). Its presence in the packet cannot be accounted for.

### GENERAL OBSERVATIONS.

By far the greatest number of enquiries concern fruit-tree insects and many relate to spraying programmes. Growers in general appear to be keen to apply the results of research and to act upon advice. Increasing numbers are contemplating more intensive spraying, especially where they are faced with the necessity for controlling Capsid Bugs and Apple Sawfly. Especially in connection with these pests, the method and time of application of the insecticide is of the utmost importance. A few selected orchards have been carefully watched in order to enable the growers to time the application correctly and marked success has attended these efforts. Particularly in connection with the use of Nicotine against Capsid Bugs, some outstanding results were obtained.

### INVESTIGATIONS.

#### 1. THE LIFE HISTORY AND CONTROL OF THE STRAWBERRY BLOSSOM WEEVIL (*Anthonomus rubi* Herbst).

This work was commenced two years ago when the writer was Advisory Entomologist at the University, Reading. The area under observation then was the Botley district of South Hants, where damage was normally severe. During this time, enquiries were also received from Mr. G. C. Johnson in East Sussex concerning the insect. Control experiments have been started in the Chailey district of East Sussex this year. The weevil has also been found in many parts of Kent, on numerous wild and cultivated plants. The Life History has now been fully worked out and a complete account is in the course of preparation. A preliminary note was published in the *Journal of the South-Eastern Agricultural College*, Vol. 28, 1931, pp. 147-152.

#### 2. AN INVESTIGATION INTO THE CRANE FLIES (*Tipulidae*) OF ECONOMIC IMPORTANCE.

This work was also commenced at Reading and is being continued. A considerable amount of material has been accumulated on which to work as time permits, and further breeding and collecting of various species is going on.

### 3. THE GROWING OF PYRETHRUM (*Chrysanthemum cinerariacfolium*).

Under a scheme initiated by the Plant Pathological Laboratories of the Ministry of Agriculture, investigations have been continued with a view to obtaining information as to the possibility of growing Pyrethrum in this country for the purpose of manufacturing an insecticide from it. The half-acre plot established has yielded its second crop this year. The crop was a large one, the weight of wet flower heads exceeding a ton, and yielding 6 cwts. of dried material for extraction. Various methods of harvesting were tried out and finally the majority of the crop was dealt with by a method which proved about twice as rapid as hand picking. The cost of harvesting still remains very high, however, and attempts are being made to effect a further reduction. Complete and detailed costs of harvesting, drying and cultivation have been obtained from this plot. The crop was sold at a substantial profit.

### 4. CAPSID BUG INVESTIGATIONS.

Mr. M. D. Austin, who for the past few years has been engaged in a study of the Bionomics and control of various Capsid Bugs of economic importance, has continued this work. Co-operation with the Department of Chemical Research has resulted in the expansion of the testing of various insecticidal materials, particularly ovicidal washes. Some of this work was already in hand as a natural result of experiments carried out in the previous year; certain other lines have been developed more recently, in which Mr. H. Martin, Mr. M. D. Austin and the writer have all been concerned. It has been thought advisable, however, to include all this work in the separate report appended, which, though it deals primarily with investigations on which Mr. Austin has been particularly engaged, also includes those in which all have co-operated.

### 5. THE EFFECT OF PYRETHRUM EXTRACT ON THE GRAIN WEEVIL (*Calandra granaria* L.).

As the result of an enquiry, a grain store, temporarily empty, was found to be heavily infested with the grain weevil (*Calandra granaria*). The building did not admit of fumigation and an attempt was made to deal with the insects by the use of a Pyrethrum wash. A strength of 1 gallon of extract in 80 gallons of water was tried but failed to give a satisfactory kill unless the insects were very thoroughly wetted, and even then some survived. Small scale laboratory experiments showed that a strength of 1 gallon of Pyrethrum in 40 gallons of water was necessary to effect a good control, and the insects only slightly wetted at this strength all succumbed within a few days. Observations in the store seem to show that very thorough application of the wash into all crevices is necessary.

## LECTURES AND DEMONSTRATIONS.

No definite course of lectures in Entomology has been given by this department but Mr. Austin and the writer carried on the course, for which Mr. C. A. W. Duffield was responsible, during his illness, amounting to four lectures.

As a co-opted member of the Kent Branch N.F.U. Fruit and Vegetables Committee, the writer was invited to read a paper to that Committee on the Colorado Beetle, the Cherry Fruit Fly and the American Apple Borer (Railroad Worm).

The Summer Conference of Advisory Entomologists and Mycologists at Aberystwyth was attended, in July.

Two Provincial Conferences, Horticultural Section, held at Worthing and Wye respectively have been attended. At the latter, in conjunction with Prof. E. S. Salmon and Mr. J. Turnbull, a paper was read on the subject of "An Orchard Spraying Programme."

Exhibits, dealing particularly with Capsid Bugs on Apples and Currants were staged at the County Show, Canterbury, and at the Tunbridge Wells Show.

A monthly note in the column of the Kent Branch N.F.U. *Journal* entitled "Insect Pests" has been contributed.

### CO-OPERATION.

Reference has already been made to work done in conjunction with Mr. H. Martin of the Department of Chemical Research, and field scale trials of various types of insecticidal materials have been made with encouraging results and are being continued. In order to obtain general uniformity in advice on spraying, discussions with the Department of Mycology have taken place, particularly with regard to the use of Lime-Sulphur, which is of value not only from the point of view of certain fungous diseases, but plays an important part in controlling the Fruit Tree Red Spider. Mr. W. M. Ware has been of great assistance in providing information about Mushroom troubles in West Sussex.

All those engaged in giving Horticultural advice in Kent have endeavoured to keep in close touch with each other by arranging periodic meetings, which are attended by members of the County Staff, East Malling Research Station and the College. These meetings have proved most useful and a combined article was sent to the Kent Branch N.F.U. *Journal* this autumn on the subject of Winter Washes for Fruit Trees, outlining the advice which all those concerned deemed to be best.

In Kent, Messrs. G. H. Garrad, G. Kent, R. Hart and W. Corbett have sent enquiries, and a conjoint trial of Winter Washes against the Apple Capsid Bug has been carried out at Swanley by Messrs. G. Kent and M. D. Austin. Mr. G. C. Johnson in East Sussex has been of great assistance in connection with Strawberry Blossom Weevil investigations in that area, and has also sent many enquiries. Mr. F. W. Costin in West Sussex has been especially helpful on the subject of Mushroom pests, and Mr. J. H. Mattinson from Surrey has provided general enquiries, more especially in connection with the prevalence of Potato Eelworm in that county.

### PUBLICATIONS BY S. G. JARY.

1. A NOTE ON THE STRAWBERRY AND RASPBERRY BUD WEEVIL (*Anthonomus rubi* Herbst). *Jour. S.E. Agric. Coll.*, Vol. 28, 1931, pp. 147-152.

An account is given of preliminary investigations into the life history of this weevil, as it occurs in South Hants. Hibernation, egg-laying and feeding habits are described and the approximate duration of the various stages given. The possibility of various types of control measures are discussed.

2. SOME OBSERVATIONS ON WINTER MOTH CATERPILLAR ATTACKS ON FRUIT TREES IN 1929-1930. *Jour. S.E. Agric. Coll.*, Vol. 28, 1931, pp. 137-146.

The time of emergence and the period of maximum emergence of Winter Moths, especially *Cheimatobia brumata* L., is recorded, from two Berkshire orchards. Egg-laying

habits were studied, with reference to the possibility that some eggs may escape contact with Winter Washes. The degree of control obtained by Winter Washes of various types was studied both in the field and laboratory.

## APPENDIX.

### REPORT ON CAPSID BUG INVESTIGATIONS AND TRIALS OF INSECTICIDAL MATERIALS, CARRIED OUT BY MR. M. D. AUSTIN.

Research on the bionomics and control of certain Capsid Bugs has been continued. The species concerned have been the Apple Capsid (*Plesiocoris rugicollis* Fall.), the Common Green Capsid (*Lygus pabulinus* L.) and the Tarnished Plant Bug (*Lygus pratensis* L.).

#### 1. *Plesiocoris rugicollis* Fall.

##### CONTROL EXPERIMENTS.

The use of certain ovicidal washes to control this insect has been studied at two centres, Hernhill and Selling. Four varieties of Apples have been involved, King Edwards, Bismarcks, Worcester Pearmain and Yellow Ingestres. At Hernhill six different types of washes, all proprietary articles, were used. At Selling, washes made in the Department of Chemical Research by Mr. H. Martin, from Tar and Petroleum Oils of known specifications were employed. The results of these trials have not yet been treated statistically, but there are indications that some of the washes have given a very high degree of control. At Swanley, Mr. G. Kent, County Horticultural Advisory Officer, has carried out a trial along similar lines, using proprietary washes, in co-operation with the Department of Entomology.

##### BIONOMICS.

The date of hatching of this Capsid is found to vary considerably in different districts. An attempt has been made to survey the county with regard to the hatching date, in order that more accurate information may be given to growers as to the correct time at which to commence the application of Contact Washes in the spring. Mr. G. Kent, the Entomological Department of the East Malling Research Station and the Swanley Horticultural College have co-operated in the survey.

#### 2. *Lygus pabulinus* L.

##### CONTROL.

One field experiment was conducted at Selling on Black Currants, using washes prepared by the Department of Chemical Research similar to those used on Apples. Two different washes were tested, both of which gave a very high degree of control. This work will be considerably extended during the winter of 1931-1932.

A subsidiary laboratory experiment was made on rooted Red Currant twigs. Washes which included Petroleum Oils, Tar Oils, Vegetable Oils and combinations of these, at different strengths, were tested. The washes again were supplied by the Department of Chemical Research. The statistical treatment of the results has given valuable information, upon which the composition of washes for future field trials can be based.

Contact insecticides have been tried out on a small scale in order to obtain information on the effect of certain proprietary spreaders.

## BIONOMICS.

This Capsid has been noted doing severe leaf and shoot damage to hops, and its migratory habits have been further studied in this connection.

3. *Lygus pratensis* L.

The agricultural authorities in West Sussex invited the co-operation of this department in the autumn of 1930, on account of severe damage by this bug to Chrysanthemums at Worthing. Visits were made to the affected nurseries and investigations commenced. Small scale experiments at Wye showed the value of Nicotine as a contact wash and it is proposed to try out other contact washes and dusts. The life history of the insect does not appear to have been worked out fully in this country although it is one of our most common Capsids. Information thus far obtained seems to show that it usually hibernates in the adult stage and the destruction of suitable accumulations of rubbish in nurseries is probably of importance in controlling attacks. The possibility of the egg stage existing in the winter has not, however, been overlooked. Oviposition has been noted in the spring, by over-wintered females, and a paper on this matter has been published. *Ent. Mo. Mag.*, LXVII. More complete data on this insect will be contained in a paper now in the course of preparation.

4. *Calocoris norvegicus* Gmel.

This Capsid, common as a rule on Hops and Potatoes, has been studied and oviposition observed. The damage done by it appears to be important, especially as there are indications that a more or less severe type of injury follows the application of Bordeaux mixture to attacked foliage.

5. *Investigations into the Efficiency of certain Insecticides.*

This work has again been done in conjunction with Mr. H. Martin of the Department of Chemical Research, where the materials in question have been prepared or made up. The following is a brief account of the scope of the work :—

(a) The effect of Winter Washes prepared from oils of known specification, against the eggs of Apple Aphides, Winter Moths, Apple Sucker, Fruit Tree Red Spider and the Pear Leaf Blister Mite.

(b) The use of Contact Washes against Hop Aphis (*Phorodon humuli*), designed to give information as to the extent to which the insecticidal action of Nicotine is influenced by the type of spreader used with it. The possibility of the incorporation of Nicotine in Copper fungicides was also examined.

(c) The transmission of Virus diseases of the potato is known to be associated with certain insects, particularly the Aphis, *Myzus persicae*, so that theoretically it should be possible to keep a crop free from the diseases by controlling these insects. Washes of combined fungicides and insecticides have been applied for this purpose, in an effort to deal with the insects and simultaneously to give protection against "Potato Blight" (*Phytophthora infestans*). The value of the washes has been estimated by the control of Aphides and Capsid Bugs, and also by the evidence of Virus diseases on the plants themselves. This experiment is now in its second year and will be continued, using "seed" tubers from plots under various treatments.

## PUBLICATIONS BY M. D. AUSTIN.

1. "Capsid Pests of Chrysanthemums: A Preliminary Note." *Market-Grower and Salesman*, VIII, No. 28, p. 14. April, 1931.
2. "Control of Apple Capsid." *Jour. Min. Agric.*, XXXVIII, No. 2, pp. 154-162. May, 1931.
3. "A Contribution to the Biology of the Apple Capsid (*Plesiocoris rugicollis* Fall.) and the Common Green Capsid (*Lygus pabulinus* Linn.)." *Jour. S.E. Agric. Coll.*, XXVIII, pp. 153-168, 8 figs. July, 1931.
4. "Observations on the Hibernation and Spring Oviposition of *Lygus pratensis* Linn." *Ent. Mo. Mag.*, LXVII, pp. 149-152, 3 figs. July, 1931.
5. "Hemipterous Pests of Chrysanthemums." *Fruit-Grower*, LXXII, pp. 49-50 and pp. 83-84. July, 1931.

## MYCOLOGICAL DEPARTMENT

By PROF. E. S. SALMON and W. M. WARE.

### ADVISORY AND EDUCATIONAL WORK.

On October 13th a paper was read before the London Section of the Institute of Brewing on "Hop-breeding Experiments at Wye College, 1917-30." On November 3rd a lecture on "Fungous Diseases of Plants and their Control" was given at Tilney St. Lawrence, Norfolk, under the auspices of the Ministry of Agriculture and Norfolk Agricultural Committee. On November 19th a lecture on "Hop Downy Mildew and its Control" was given at Bentley, Hampshire, to the local branch of the National Farmers' Union. On January 15th, at the Hopgrowers' Conference held at Wye College, lectures were given on "Hop Downy Mildew" and on "New Varieties of Hops." On February 18th a lecture on "Hop Downy Mildew" was given at the Borden Farm Institute, Kent. On September 29th a paper on "The Year's Orchard Spraying Programme" was read at the Wye Provincial Horticultural Conference, held at Wye. Mr. W. M. Ware has given lectures to gardeners on the control of fungus diseases of fruit and vegetables at a number of centres in the county.

The Conference of Advisory Officers of the Ministry of Agriculture was attended; also the winter meeting in London of the Virus Committee and the summer meeting of the same Committee at Cambridge. By request, we served on the Deputation from the Kent County Council to the Ministry of Agriculture on the subject of the compulsory control of Hop Downy Mildew. The Meetings of the Sub-Committee on Hops of the Research Committee of the Institute of Brewing have been attended. The Wye Provincial Horticultural Conference in June at Worthing was attended.

Exhibits of Fungous Diseases of Fruit, Mushrooms and Hops were prepared for the Kent Agricultural Show at Canterbury. Exhibits were also sent to the Agricultural Section of the Kent County Fair at Maidstone.

A course of lectures on Fungous Diseases of Fruit has been given to students at the College in the Horticultural Diploma and Certificate Courses, and on Hop Diseases to students taking the course in Hop-growing.

Dr. Kunkel, of the Boyce Thomson Institute, U.S.A., and Dr. H. Hart, of Minnesota University, U.S.A., have visited the Department to see the work in progress.

Among the large number of plant diseases examined, the following may be noted: Crown Gall (*Bacterium tumefaciens*) on Chrysanthemum, variety Edith Cavell, on the stem at ground level. This occurred on a single plant in a large crop under glass early in January. Crown Gall, present for several years on cultivated Blackberries on the College farm, was conspicuous in late summer on the variety Himalayan Giant not only at ground level but also on the fruiting canes of the current year. The galls were numerous on canes trained at a height of 3 or 4 ft. from the ground and usually occurred at the base of the fruiting laterals. There was some indication that galls appeared also at places where the canes had been bent or rubbed. Loganberries near Wye, in a plantation which had cropped heavily in 1930, were also infected and in May, 1931, about 100 plants out of 4,000 were reported to have been killed.

On March 21st, the ejection of mature ascospores of the Apple Scab fungus (*Venturia inaequalis*) was noted. The dead leaves bearing the perithecia were brought to the laboratory by a grower who was anxious himself to investigate the source of Scab in his plantations.

*Zopfia rhizophila* and *Rhizoctonia* sp. were present on Asparagus roots in a garden at Penshurst (a second case to that mentioned a year ago). Whole beds of Asparagus were destroyed. No fresh plants had been introduced to the garden for at least seventeen years, all fresh stock having been raised from seed. *Puccinia mirabilissima* was found in April on *Mahonia aquifolium* at Barnham, Sussex, and later at Wye, Kent. This fungus, recorded in England only since 1930, causes spotting of the leaves and defoliation. Fructifications of *Stereum purpureum* were found during May on the dead part of a large branch of a Newton Wonder apple tree bearing silvered foliage in a plantation at Wye. *Fusarium* bud-rot of the Apple was noted on the variety Grenadier at Teynham, Kent and on the variety Bismarck at Selling, Kent, in May. Dry, hard, pink-coloured masses of *Fusarium* spores were present in the buds, rather resembling the colour of closely-folded petals. Several cases of damage to Tulips by *Botrytis tulipae* came to our notice.

A fungus present on decaying roof-timbers of a church at Maidstone and sent to us by the Agricultural Organiser of Kent was identified by Mr. J. Ramsbottom as *Phellinus cryptarum* Karst. Mr. Ramsbottom informed us that he had seen it occasionally in this country though it has probably not yet been recorded. The fungus is described in the *Report of the International Conference of Phytopathology and Economic Entomology*, Holland, 1923, p. 196.

Brown Rot attack on the blossom trusses of large Cherry trees of the varieties Circassian and Governor Wood was specially severe in an orchard near Sittingbourne in May. On some of the Circassian trees, thirty years old and about 40 ft. high, all of the blossom trusses were brown and wilted and covered with the fungus.

Cricket-bat Willows, grown near Wye, were found to be attacked by a fungus *Discella carbonacea* which caused large cankers on the branches. The fungus was identified by Miss E. M. Wakefield of Kew. *Helminthosporium teres*, causing Net Blotch of Barley, was of common occurrence. One further instance of Lavender Blossom Wilt (described *S.E. Agric. Coll. Journal*, 28, 1931) was received from Cranleigh, Surrey, at the end of June. Zinnias grown under glass at Plumpton, Sussex, and approaching the flowering stage, were received for examination on June 27th. The main stems (1½ ft. high) were attacked by a fungus which was causing a rot of the upper 8 inches; the blossom head consequently hung limply down. Copious white mycelium covered the rotted part, and sclerotia, up to 14 mm. in length, were present. On parts of the stem not covered with mycelium, *Botrytis* conidiophores were abundant.

On July 4th, shoots of Elm were received from the Secretary of the Croydon Horticultural Society, Surrey. These were from one to three years old and were cut from two young trees about ten years old growing in a villa garden. It was stated that some of the upper branches were dying back to the stem and "had only developed the disease during the last fourteen days." On some of the shoots the leaves were yellowish and on others they were green, dry, and withered. No brown flecking in the sap-wood was noticed and no hyphæ were found on staining with Cotton Blue. The external symptoms agreed with those of the Dutch Elm Disease caused by *Graphium*

*Ulmi* and this diagnosis was confirmed by the Forestry Commission when further specimens were submitted to them from Croydon.

Morello Cherry fruits with dark olivaceous spots (2 mm. to 3 mm. diam.) were received from near Worthing on July 14th. The fungus concerned was *Fusicladium Cerasi*. Light brown spots on leaves of Onions of five different varieties, sent on July 18th from near Salisbury, were found to be caused by a fungus agreeing closely with *Heterosporium Allii* var. *Cepivorum* described as a new variety by G. Nicolas and Mlle. Aggery in *Rev. Path. végét. et d'Ent. agric.*, 14, p. 195, 1927. Strawberry plants from a grower near Hereford were attacked on leaves and sepals by *Marssonina Fragariae*. The trouble was said to be present on twenty acres of young strawberries and it was stated that the fruits themselves were attacked. *Marssonina panattoniana* on Cos Lettuce was received from Hellingly, Sussex, at the end of July. Wart disease of Potatoes (*Synchytrium endobioticum*) was sent on August 21st by the Assistant Agriculturist of the Kent Education Committee who obtained the specimens from a garden near Sevenoaks and from a field near Edenbridge. The first was said to be the variety Sir J. Llewelyn and the second White Rose. During the season, many enquiries on potato diseases and specimens of Skin Spot, Silver Scurf, and Common Scab were received. At the beginning of September a crop of Potatoes (variety Majestic) grown at Swanley was found at the time of digging to be severely attacked by Common Scab. Many of the tubers sent were covered with such closely adjoining scabs that no smooth part of the skin remained. The grower reported that the field had not been limed for the past four years. It was a clover ley and had been manured with 25 tons of London dung and 10 cwt. of Peruvian guano per acre.

The "Small Hop" disease, and the occurrence of masses of buds on the rootstock (the one possibly related to the other) were again met with in 1931. At the end of March and at the beginning of April specimens of hop rootstocks bearing hundreds of buds in dense clusters were received from Paddock Wood (variety Fuggle) and from Goudhurst. Specimens of laterals bearing small hops were sent from Faversham and from Benenden, Kent, in September of the same year. In both cases only one hill in an entire garden showed the symptoms. These rootstocks will be sent to Wye for examination. It is of interest to record that one or the other of the symptoms (small hops or prolific bud-formation), and sometimes both, have now been met with annually over a period of six years in Hampshire, Kent and Sussex.

#### RESEARCH WORK.

The following investigations have been made :—

1. THE DOWNY MILDEW OF THE HOP (*Pseudoperonospora humuli*). The season of 1931 will long be remembered by hop-growers as one of the most disastrous, owing to the prevalence of disease. Encouraged by abnormally wet weather, the Hop Downy Mildew became rampant both in the spring and early summer, when it attacked the bine to a greater extent than known hitherto in this country, and also in late summer, when it attacked in virulent manner both burr and ripening cones. Hundreds of acres of hops in the earlier stages of growth or with the cones turned brown by the mildew were abandoned as useless.

We recorded in our Report in the *Journal* for 1931 (p. 52), that the Fuggle variety (completely resistant in 1927) was attacked in certain districts in 1930. In 1931 the resistance of this variety to the disease was lost almost completely; in Kent, Sussex

and Hampshire it was no uncommon sight to see in gardens of Fuggles the cones rapidly turning brown before they could be picked. It is clear that, in the future, systematic spraying with Bordeaux mixture will be necessary for every variety of hop grown in this country.

The efficacy of Bordeaux mixture in controlling the disease was tested to the full under the constant heavy rains of the 1931 season ; in no case where home-made Bordeaux mixture was well applied after proper " spiking " did it fail to secure a healthy crop. The Hop Conference held at Wye College on January 15th was largely attended, and by this and other means copies of our leaflet on the Control of Hop Downy Mildew (3) were in the hands of a very large number of hop-growers. The Hereford and Worcestershire Hop-growers' Association purchased copies to distribute to all members. The success of the measures advocated has been visible in the considerable number of sprayed gardens in Kent, and it is gratifying to record that letters reporting similar success have been received from Sussex, Hampshire, Worcestershire and Herefordshire. These letters showed that in all cases where the grower had made the Bordeaux mixture and applied it before the disease had progressed too far, he obtained ocular proof of the value of spraying—so much so that in several cases growers expressed the view that Downy Mildew is no longer to be feared.

A party of growers during the summer made the journey from Hampshire to discuss the situation which had then become serious in their worst attacked gardens. Some weeks later Mr. W. M. Ware spent two days in the Hampshire hop gardens, and was instrumental in assisting the growers to understand the situation and to take what measures were then possible. In September a short tour was made of the Kent and Sussex Weald, where visits were paid to growers of Fuggles and advice was given as to the treatment of the gardens in 1932.

Whilst a certain number of growers in Kent, as the result of previous experience, were familiar with the method of making and applying Bordeaux mixture, many others required assistance. Visits were paid, often in company with Dr. W. Goodwin, to a number of farms, where the preparation of Bordeaux mixture and its application by hop-washers were demonstrated.

The wet season of 1931 showed the necessity for making the operation of " spiking " still more rapid and still more thorough in many hop gardens.

Advances have been made in the technique of spraying. Three good sprayings have been found to be sufficient to secure a healthy crop. In the first application, when the bine has reached the top, a fine, misty spray should be employed, and about 150 gallons to the acre ; if heavier applications are given, there is the risk of injuring the leaves (particularly if *Aphis* is prevalent). In the second and third sprayings, just before and just after the " burr " period, larger amounts, up to 300 gallons to the acre, should be applied, particularly if the bine is heavy ; there is no fear of " scorching " at those two stages of growth. Another point of very considerable practical importance, has been discovered, *viz.* that it is quite safe to spray hops when in burr with Bordeaux mixture. No harm is done to the " burr," and normally-seeded cones are produced. In a season where persistent wet weather occurs, and the ground becomes too wet for the tractor or hop-washer, the carrying out of the second application is often very difficult ; the burr period provides a further fortnight or so when the work can be carried out.

Whilst many growers sprayed their hops at the right stages of growth, and *prevented* the attacks of the mildew on the cones, without spraying the latter (which were consequently without signs of copper), other growers delayed adequate spraying until the cones were formed, when (in several cases) a heavy application of Bordeaux mixture was given, with the result that the cones when ripe showed an appreciable amount of copper. Brewers strongly object to the presence of copper on English hops; and since it has now been proved, during a summer most advantageous to the disease, that Bordeaux mixture on the hops themselves is quite unnecessary, growers will be well advised to discontinue such late sprayings.

2. SPRAYING EXPERIMENTS AGAINST APPLE SCAB. In conjunction with Dr. W. Goodwin, spraying experiments have been carried out during 1931 at two centres, (1) on a farm near Teynham, and (2) in the College plantation at Wye. At Teynham plots of Worcester Pearmain and Allington Pippin were sprayed three times with either (a) home-made Bordeaux mixture, or (b) Lime-Sulphur. The whole of the crop will be graded by hand for the amount of scab present. Experiments have now been carried out at this centre for three consecutive seasons, and the results, which are very satisfactory, will be published shortly. At Wye, home-made Bordeaux mixture was used (for the fifth consecutive season) on Allingtons and Newton Wonders, and a second plot received Lime-Sulphur. The entire crop will be graded by hand, and the results recorded in the *Journal of the South-Eastern Agricultural College*.

The results of the spraying experiments at Wye in 1930 have been published (7). The trees of Allington Pippin sprayed three times with home-made Bordeaux mixture gave 15 per cent. of scab-affected apples; sprayed at the pink-bud stage with Bordeaux mixture followed by two post-blossom applications of Lime-Sulphur (1:59), 22 per cent. of scab-affected apples. In the three control (unsprayed) plots the percentages of scab-affected apples were 73, 76 and 76. Trees of Newton Wonder sprayed three times with Bordeaux mixture gave 26 per cent. scab-affected apples; sprayed at the pink-bud stage with Bordeaux mixture, followed by one post-blossom application of Lime-Sulphur (1:59), 81 per cent. In the three control (unsprayed) plots the percentages of scab-affected apples were 88, 85 and 91. On Newton Wonder, the application of Lime-Sulphur (1:59) immediately after the fall of the petals, resulted in serious leaf-fall, while the same treatment caused little damage to Allington Pippin. No "russetting" of commercial importance was caused by Bordeaux mixture on Allington Pippin, and none at all on Newton Wonder. In all, 4 tons 4 cwt. of apples were graded by hand for scab.

An account has been published (6) of spraying experiments carried out in 1924 and 1925 on Mr. P. Manwaring's farm, Marden. The variety was Bramley's Seedling. The two control (unsprayed) plots taken together gave the following percentages of scab-free apples: 1924, 29; 1925, 28. The plot sprayed three times with Bordeaux mixture gave 70 per cent. scab-free apples in 1924 and 68 per cent. in 1925—increases in percentage of 41 and 40 over the control plots, and of 21 and 11 over the plot sprayed three times with Lime-Sulphur. The plot sprayed three times with Bordeaux mixture, compared with the plot sprayed twice, showed an increase in percentage of 21 in 1924 and of 15 in 1925. The plot sprayed three times with Lime-Sulphur, compared with the plot sprayed twice, showed an increase in percentage of 24 in 1925. No increase in fungicidal power was obtained in either year when Arsenate of Lead was added to Lime-Sulphur. No scorching injury ("russetting" or leaf-fall) of any

commercial importance was caused by any of the sprays used. The entire crop (8 tons 16 cwt.) was graded by hand for scab.

As a result of the biological observations made in the sprayed orchards, a new fact in the life history of the Scab fungus has come to light (4). In May, 1931, it was discovered that Scab pustules bearing abundant conidia, were present on the lowermost scales of the blossom-buds—a part of the tree where it has not hitherto been reported. The fungus had clearly over-wintered in this manner, and it is very probable that spores pass from the pustules on the bud-scales to the leaves as they open. Up to the present this type of infection has been found only on the variety Worcester Pearmain. Its occurrence, if general, will make pre-blossom spraying all the more necessary.

3. IMMUNITY STUDIES. The study of the resistance of varieties of hops to "mould" (*Sphaerotheca humuli*) has been continued. Male plants immune to mould have been discovered among Californian seedlings and others have been raised by crossing the English variety "Bates Brewer" with an immune American male hop. A female plant (OW95) immune to mould has been raised from the New Seedling "M45" by crossing it with an immune male from Oregon; this is being tested on commercial lines at East Malling Research Station.

#### 4. VIRUS DISEASES OF THE HOP.

(a) *Mosaic Disease*.—A further grant was obtained from the Ministry of Agriculture for the study of this disease, and Mr. D. Mackenzie was again appointed as temporary Assistant for six months. Mr. Mackenzie successfully grafted in the Nursery a large number of different varieties of hops, and obtained further proof of the existence of "carrier" varieties, *i.e.* plants which can carry and transmit the virus while themselves showing no signs of disease. Grafting was also carried out in a commercial hop garden and evidence obtained that the Fuggle variety can "carry" the Mosaic virus. It would appear that two classes of Mosaic "carriers" exist, (1) "carriers" which readily transmit the disease when planted near susceptible varieties (New Seedlings raised at Wye belong to this class); (2) "carriers" which do not transmit the disease under conditions obtaining in hop gardens (Fuggle, and probably Colgate and Tolhurst, belong to this class).

In 1929 healthy hop plants were placed in soil collected from around the roots of hops killed by Mosaic disease. Over one hundred plants are being grown thus, together with the same number of clone-plants (controls) grown in uncontaminated soil. No signs of disease have appeared in any of the pots up to the present. The experiment will be continued for another year. \*

(b) *Chlorotic Disease*.—Proof has been obtained that this disease (unlike Mosaic disease) is transmissible by sap; further experiments with different varieties have been carried out. Chlorotic plants have been grafted with scions from Mosaic-"carriers" and vice versa. Experiments have shown that the characters of the Mosaic and Chlorotic diseases may be produced in one and the same plant, and that Mosaic-"carrier" plants may be induced to show definite symptoms of Mosaic disease some time after inoculation with the virus from Chlorotic plants.

During the season, a considerable amount of material has been received from hop growers in Worcestershire and the presence of the Chlorotic disease (hitherto known in this country only on one farm in that county) has been confirmed on plants from

farms in three fresh localities. According to growers' statements, the disease has occurred on the varieties Fuggle, Early Bird and Tutsham. We are indebted to Mr. C. E. Pearson (of the Ministry of Agriculture) for help in investigating some of these cases.

(c) "*Nettlehead*" Disease.—Instances have occurred of this disease on the varieties Tolhurst (Kent) and Early Bird (Worcestershire), and living material has been collected for further study.

#### 5. HOP "CANKER."

This well-known disease, caused by a species of *Fusarium*, occurs usually at the junction of the bine and rootstock. An unusual form, in which the bine is attacked, not at its base but higher up, was met with in 1924 and 1930, and has been described (5). The names "Rootstock Canker" and "Bine Canker" are suggested for the two forms of the disease.

#### 6. FUNGICIDES.

In collaboration with the Chemical Research Department, the fungicidal powers of the below-mentioned substances, with respect to the conidial stage of the Hop Powdery Mildew (*Sphaerotheca humuli*) were investigated:—vegetable oils (crude and refined), alcohols, phenols and salicylanilide.

#### 7. LAVENDER BLOSSOM WILT.

An article giving the results of experiments which show that a form of *Botrytis cinerea* is the cause of this disease, has been published (8).

#### 8. MUSHROOM CULTIVATION AND DISEASES.

Following the Conference of Advisory Mycologists held at Wye in June, 1930, mentioned in our last Report in the *Journal* for 1931 (p. 48), a request was received from the Ministry of Agriculture to revise the Ministry's Leaflet No. 276 which deals with the whole subject of Mushroom growing. This revision was carried out and will appear as an illustrated Bulletin of the Ministry.

Contact by correspondence and by visits has been made with some of the principal suppliers of Mushroom spawn in this country. Whereas brick-spawn is made in England, the pure-culture spawn has been and is imported from the U.S.A. and the Continent. The importation from the U.S.A. has been proceeding since 1926-27 and the advantages of using pure-culture spawn are such that it has been replacing brick-spawn for use on a commercial scale. During the past year, methods of making pure-culture spawn have been investigated in this Department, and several horticulturists have visited Wye to receive instruction in the laboratory technique. As a result, in this short period, home-produced pure-culture spawn has become available, and was first put on the market in September, 1931.

Visits to mushroom growers' premises have been fairly numerous and include a tour of the Worthing district under the guidance of Mr. F. W. Costin, Horticultural Superintendent of West Sussex. The "Bubbles" disease of Mushrooms (*Mycogone perniciosa*) was found to be very prevalent and the Plaster Mould (*Oospora fimicola*) occasional. On one bed an unusual infestation of the mushrooms was noted. The

fungus concerned was identified as *Dactylium dendroides* though the possibility of its being a parasite does not appear to have been hitherto suspected. All the above fungi, as well as a species of *Verticillium* under investigation, have been kept in culture in the laboratory and an exchange of cultures, as well as correspondence, with workers in the U.S.A. has been carried out.

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## HOPS

By PROF. E. S. SALMON.

THE breeding of new varieties of hops and testing them for resistance to disease and for their commercial value as regards yield, aroma and flavour and amount of resins has been continued. A summarised account of the results obtained up to 1930 has been published (1). Seedlings have been raised from several of the "Manitoba" seedlings (which produce in this country hops as high in preservative value as American hops grown in America), with the object of obtaining, if possible, similar seedlings with an English aroma. A class of seedlings (raised from the "Bramling") has been obtained of a semi-dwarf nature; investigations will be made as to whether these possess commercial value.

The Fourteenth Report on the Trial of New Varieties of Hops, 1930, has been published (3). Among the chief features of interest are the following: (1) Of the 170 varieties (New and Commercial) tested, 91 cropped at the rate of 20 cwt. or more to the acre. (2) In all the classes (Early, Midseason and Late varieties), certain New Varieties proved on analysis to be richer in preservative qualities than any of the Commercial Varieties. (3) Three New Varieties (C9a, 411 and OF27) were richer in preservative qualities by 1.47, 0.66 and 0.11 per cent. respectively, than the richest sample of American hops obtainable. (4) In experiments in which the varieties Tutsham and Y90 were sprayed five times, when in burr, with Bordeaux mixture, normal seeded cones were produced. These cones, although receiving no later spraying of Bordeaux mixture, proved to be completely protected against the attacks of Downy Mildew.

Arrangements were made with two hop growers in Berkshire and in Kent, to try to secure the growing of a certain Seedling Variety ("Y90") in a seedless condition. The results obtained with the few hops grown in 1931 are promising, and the experiments are being continued.

Under a grant from the Institute of Brewing, Mr. A. H. Burgess has continued his investigations on drying and manuring hops. With the assistance of Mr. H. Martin and Mr. L. W. Walker, chemical analyses of 218 samples of hops and biological tests on 78 samples have been made.

A report on the work carried out in 1928 and 1929 at the Experimental Kilns, erected at Paddock Wood, by the Institute of Brewing, has been published (1).

The manuring experiments at Chilham, which have now been carried on for ten years, have served the purpose for which they were designed; it has, therefore, been decided to discontinue them after this year.

Advice has been given upon the construction of new oast houses and the improvement of existing ones, also upon manurial and other soil problems connected with hop growing.

A series of special lectures on Hop Growing were given to students at the College during the spring and summer terms. Lectures on Hop Drying and Manuring were

also given to the Maidstone and Alton (Hants) branches of the National Farmers' Union and at the Hop Conference held at Wye College in January last.

A visit was paid to the Research Station of Imperial Chemical Industries at Jealotts Hill to inspect the apparatus in use for the experimental drying of grass.

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- (3) SALMON, E. S., 1931. Fourteenth Report on the Trial of New Varieties of Hops. (Ashford : August.)

## HOP RESEARCH SCHEME

### HOP EXPERIMENTS—WYE FIELD.

A. H. BURGESS.

THE experiments upon the time of application of quick-acting nitrogenous manure and the time of cessation of deep cultivation, which were described in the Report for 1929-30, have been continued. The type of treatment of individual plots is the same from year to year.

The manurial treatment was as follows :—

6 cwt. per acre Superphosphate, and 2 cwt. per acre Muriate of Potash applied over the whole garden in March.

In addition the plots received :—

PLOTS M1.	3 cwt. Farmyard Manure	(= 15.13 tons per acre)
	37 lbs. 14 ozs. Flock Dust	(= 33.81 cwt. per acre)
PLOTS M2.	14 lbs. 13 $\frac{3}{4}$ ozs. Sulphate of Ammonia	(= 13.27 cwt. per acre)
	20 lbs. 13 $\frac{1}{2}$ ozs. Superphosphate	(= 18.61 cwt. per acre)
	3 lbs. 8 ozs. Muriate of Potash	(= 3.13 cwt. per acre)
PLOTS M3 to 7.	3 cwt. Farmyard Manure	(= 15.13 tons per acre)
	8 lbs. 0 ozs. Sulphate of Ammonia	(= 7.14 cwt. per acre)

The dates of application of Sulphate of Ammonia were (i) May 12th-16th ; (ii) June 9th ; (iii) June 26th-27th ; and (iv) July 14th.

The garden appeared to be quite free from Downy Mildew at the end of the 1930 season ; “ spikes ” appeared, however, in the spring of 1931 a fortnight after the hops were dressed. Although these and subsequent “ spikes ” were removed, fresh “ spikes ” continued to appear throughout the season. At the beginning of June the disease appeared on the lower leaves of the plants ; these were therefore stripped to a height of 18 inches. The stripping was extended to a height of 4 feet at the end of June. Spraying with Bordeaux mixture was carried out on June 24th and was repeated four times. The Canterbury Goldings were at all stages more affected by the Downy Mildew than were the Early Birds and Cobbs.

Aphids appeared at the end of May and were troublesome throughout the growing period ; fresh “ fly ” continued to come to the hops until about July 22nd. Washing with nicotine and soap was carried out five times. There was no attack of Mould but the hops were sulphured at the beginning of August as a precautionary measure. Two hills were found to be affected with Mosaic Disease ; these were cut down and grubbed.

Picking was commenced on September 3rd. The weight of green hops from each plot has been recorded, together with other details concerning the plots.

The varieties cropped as follows :—

Early Birds .. .. .	14½ cwt. per acre.
Cobbs .. .. .	12½ cwt. per acre.
Canterbury Goldings .. .. .	13½ cwt. per acre.

The results for 1930 indicate that differences in the time of application of quick-acting nitrogenous manure have an effect on the weight of the crop produced. Three series of samples, each representing the seven manurial treatments, were dried separately this season ; these samples were examined by a firm of hop merchants, who stated that they could distinguish no difference in the quality of the samples. These will be analysed for preservative substances.

A two-kiln oast has been designed and erected at Coldharbour Farm. The kilns are 20 ft. by 18 ft. and are fitted with roller floors. Each kiln is provided with a separate heating unit consisting of a fan which drives the air over five sets of gilled pipes through which steam circulates. The steam supply to each set of pipes is separately controlled, thus giving a wide range of temperature ; at 50 lbs. pressure of steam the temperature can be varied from 108°F. to 228°F. The fans are driven by electric motors fitted with speed regulators by means of which the output can be varied from 6,000 cubic feet to 12,000 cubic feet of air per minute. A recording thermometer is fitted in each kiln. Steam is supplied by a Robey locomotive type boiler ; this and the steam pipes leading from it are lagged to prevent loss of heat. A gantry is provided on the east side for the reception of the green hops.

The oast was found to be quite satisfactory in use and easy to run.

Professor E. S. Salmon reports :—

The crop of the one hundred hills of the Saaz variety was picked and dried separately. No practical means have been found of growing the crop seedless. Samples will be submitted for judgment as to aroma, to English and Continental experts.

Part-pockets of the two New Varieties C9a and 411 have been obtained. Both these varieties, which have an " American " aroma, are extremely rich in preservative properties. These pockets have been purchased by a Brewery, which has kindly undertaken to carry out trials to ascertain whether these New Varieties are suitable to take the place of American imported hops.

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## CHEMISTRY DEPARTMENT

By W. GOODWIN, M.Sc., Ph.D.

### ADVISORY WORK.

Most of the enquiries that have been received have had reference to the use of spray materials either on fruit or hops. In a number of instances visits were paid to the farms from which the enquiries came and more especially where hops were to be sprayed with Bordeaux mixture as a protection against the Downy Mildew disease. The main object of such visits was to show how the operation of making Bordeaux mixture can be simplified by the use of high grade commercial hydrated lime and a stock solution of copper sulphate. Attention was paid on these visits to the application of the Bordeaux mixture to the hops, as the success of the operation depends a great deal upon the thoroughness with which the application is made, especially in the later stages of growth when the spray has to be carried to the top of the bine. With the proper distribution and arrangement of the nozzles it was possible to get good results with the ordinary hop washer, provided sufficient pressure was maintained. Where a "blower" was attached to the hop washer the spray was distributed more regularly and to a much greater height.

In the course of these advisory visits to hop growers no difficulty has been experienced in quickly instructing the foreman or other responsible worker how to prepare Bordeaux mixture on the lines indicated above so that spraying could be carried out expeditiously and economically. It was found on all but one occasion that the hydrated lime was of good quality and was properly packed in paper bags. The copper sulphate, again with one exception, was in the form of small crystals, which is an advantage, as a solution can be prepared rapidly even with cold water if a stock solution is not available.

Both fruit and hop growers submitted samples of such spray materials as lime sulphur, Bordeaux powders, copper sulphate, lead arsenate, for examination and report. The analysis of these samples and also of the spray materials used in the apple scab trials was carried out by Mr. H. Martin, who also assisted Mr. Burgess in the biological valuation of the samples of hops which have been analysed under the Institute of Brewing scheme. These biological tests, as well as the resin determinations, have had to be made in this laboratory owing to lack of accommodation elsewhere.

Advisory work in connection with soils and manures has been again limited to enquiries which have been received mainly from the County Agricultural Organisers. Some advisory visits have been paid to fruit growers who wished to know whether the poor performance of trees could be due to soil influences. Soils have also been examined from three gardens, a bowling green and a tennis lawn, as difficulty had been experienced in cropping or in obtaining a suitable turf.

The samples of grass taken from the plots on Romney Marsh and the College Farm have been received and the dry matter in them determined, the number of samples was twenty.

The purchase of an apparatus for the determination of the hydrogen ion equivalent has enabled estimations to be made for other members of the College Research Staff.

An exhibit illustrating the nature of emulsions, spreaders, etc., was prepared by Mr. Martin and sent to the Kent County Show at Canterbury. The usual lectures have been given, (a) to the B.Sc. course on the chemistry of sprays and animal nutrition by the writer, and (b) to Horticultural Diploma students by Mr. Martin.

#### SPRAYING TRIALS.

The two series of spraying trials against apple scab which are being carried out in conjunction with the Mycological Department have been continued. The first of these series—the trials in the College plantation on the varieties Newton Wonder and Allington Pippin—was started in 1927 and was designed to compare the efficiency of Bordeaux mixture made with commercial hydrated lime with that made with home-slaked quick lime. The results showed that equally good control of the disease could be obtained with either type of Bordeaux mixture. In 1929 one of the plots (B) was sprayed with lime sulphur (1 in 60) to ascertain whether post-blossom applications of this spray gave a better finish to the fruit than did the Bordeaux mixture. It was found, however, that the lime sulphur spray caused a serious leaf fall in the case of the Newton Wonder variety but not with the Allington Pippin. In 1930 similar treatment was given to the two plots and again the Newton Wonder proved unable to stand post-blossom spraying with lime sulphur at a strength of 1 in 60. The results of the trials in the years 1927-1930 inclusive are published in the *Journal of the South-Eastern Agricultural College*, 26, 27, 28. In 1931 the spraying was again changed, on plot (B) a pre-blossom spray of lime sulphur (1 in 30) being given and two post-blossom sprays of lime sulphur (1 in 100). These latter sprays caused little or no leaf fall on the susceptible Newton Wonder trees but control of scab did not appear to be satisfactory. The crops have now been graded by hand, counted and weighed in the usual way, and the real effect of spraying will be seen when the figures are worked out.

The second series of trials was on Mr. William Colthup's farm, Provender, Norton, the varieties being Worcester and Allington Pippin. The past year was the third one of the trial and here again the use of lime sulphur with the object of improving the "finish" of the fruit was tried against Bordeaux mixture. The lime sulphur plot received a pre-blossom spray of 1 in 30 and two post-blossom sprays of 1 in 60, the other plot was sprayed throughout with Bordeaux mixture. The yields from the two plots have also been graded, counted and weighed and the results are being prepared for publication.

#### FRUIT SOILS SURVEY (with B. S. Furneaux, M.Sc.).

The third year of this survey, which is being made in conjunction with the East Malling Research Station, has now been completed. When the survey began in October, 1928, the area selected as the starting point was that portion of the Lower Greensand formation lying between Ashford and Sevenoaks. This area contains some of the best fruit tree soil in the county and is well-known to the pomological workers at the East Malling Research Station.

Mr. Gethin Jones, who was appointed soil surveyor when the survey began, resigned his appointment at the end of March, 1931, to go to the Department of Agriculture, Kenya. To preserve the necessary continuity Mr. Basil S. Furneaux, M.Sc.(Agric.)

joined the survey in February and succeeded Mr. Gethin Jones when the latter went abroad. Except for a limited amount of lecturing on Geology and Soils under Dr. Brade-Birks, Mr. Furneaux has given the whole of his time to the work of the survey.

Before leaving, Mr. Gethin Jones prepared his classification of the soils of that portion of the Lower Greensand area that he had surveyed. In this classification every effort was made to provide as simple an arrangement as possible, consistent with the satisfactory application of the system to all soils in the area. Finally, twenty-eight soil series were established and into this classification it is possible to place almost all the soils in the area. A few of these series are supplemented with *phases* to include areas in which the drainage is less perfect than in the typical series.

Mr. Gethin Jones also placed on record all the information which he had obtained in the course of his survey on the Lower Greensand and gave a detailed description of each soil series, its degree of variability, distribution and method of formation, together with chemical and mechanical analyses of representative samples.

Since Mr. Gethin Jones's departure there has been no further extension of the survey of the Lower Greensand except for a small area near Ashford. Mr. Furneaux has, however, been engaged jointly with Mr. Bane of the East Malling Research Station on an intensive study of areas and plantations of especial interest to the pomologists. Certain closely related soil series which give widely differing tree performance have been investigated and particularly in cases where bad patches of trees occur in plantations otherwise satisfactory. From this joint work it would appear that the variations of water conditions on the Lower Greensand are greater than seemed to be the case at first. The cases that have been under investigation have been chiefly on those soil series that have a wide distribution in the fruit growing areas.

A start has been made with the classification of the soils of the Hastings Beds, which give rise to the High Weald. Of the subdivisions of the Hastings Beds the Tunbridge Wells Sand has received most attention, as it is upon this formation that the orchards in this area are mainly situated. The Ashdown Sand and the Wadhurst Clay have also been surveyed to a limited extent. The area under survey at present lies between Biddenden in the east and Pembury in the west. It is bounded on the north by the Low Weald and extends as far as Benenden and Lamberhurst in the south.

As in the case of the Lower Greensand area, the American method of survey has been adopted. A preliminary investigation of the whole area was first made in order that some guidance could be obtained for the establishment of soil series and information as to their relative importance. Since then a fairly detailed survey of orchard land only has been in progress and a considerable area in the neighbourhood of Goudhurst and Cranbrook has already been covered. Profiting by experience of the Lower Greensand survey a smaller area has been selected and is being more intensively studied. At present fifteen series have been established and it is already evident that the most important factor in the differentiation into series is the natural drainage of the soils. This is made all the more striking by the small variation in lithology and the almost entire absence of drifts other than those of Hastings Beds origin.

A meeting of the Soils Correlation Committee, which is dealing with the soils in England and Wales, was held at Maidstone on May 4th. At this meeting Mr. Furneaux gave a description of the soil series of the Lower Greensand and their distribution. The

following two days were spent in touring the area and inspecting representative sections of the different soils.

At the request of the British Empire Section of the International Society of Soil Science, further data has been collected for that portion of the second soil map of Europe relating to South-Eastern England.

Exhibits illustrating the more important soil series of the Lower Greensand and of the High Weald, were staged at the Kent County Agricultural Show at Canterbury and at the Tunbridge Wells Agricultural Show.

Mr. Furneaux has contributed a paper dealing with the application in the field of the American system of soil surveying (*Journal of the S.E. Agric. College*, 28, pp. 117-122).

## THE CHEMISTRY OF INSECTICIDES AND FUNGICIDES

By H. MARTIN, M.Sc., A.R.C.Sc., F.I.C.

THE co-operation of the Research Entomological Department has made it possible to extend research to the chemistry of insecticides and the problems now under investigation may be described generally as the application of chemistry to Plant Protection. The main object underlying the work is improvement in the use of insecticides and fungicides by the discovery, (1) of new insecticidal and fungicidal substances, and (2) of means for the better utilisation of the known materials. A general defect of present-day field work on the chemical methods of plant protection is the failure to give an adequate description of the sprays and dusts employed. Attention was drawn to this lack of definition in a communication to *Nature* (Publication 1). It is encouraging to record that thirty-seven samples of such spray materials have since been received for analysis in order that better descriptions of the washes used may be given. As samples have been received from five sources other than those connected with this College, this fault may be ascribed to the lack of facilities elsewhere whereby the necessary information of the composition of spray materials may be obtained.

### 1. ANALYSIS OF OIL-CONTAINING SPRAY MATERIALS.

Work upon analytical methods for the examination of insecticides and fungicides has been devoted mainly to the proprietary tar and mineral oil preparations. An account of methods found suitable for the analysis of these materials has been published in the *Journal of the Society of Chemical Industry* (Publication 2). Work is in progress on the extension of these methods, in particular, to the analysis of preparations containing tar-petroleum oil mixtures and nicotine derivatives, to the estimation of water and emulsifier content, and to the determination of those qualities of the oil which determine value for spray purposes.

### 2. THE PREPARATION OF OIL SPRAYS.

To determine those particular properties which influence ovicidal, insecticidal or phytocidal behaviour of oil preparations, actual spray trials are necessary. For this purpose the experimenter has hitherto been confined mainly to available proprietary preparations. An attempt to discover methods for the easy emulsification of oils in the field resulted in a two-solution oleic acid method, particulars of which were published in the College *Journal* (Publication 3). By this means, emulsification of specific oils of known characteristics becomes simple and the limitation to proprietary materials is removed. Although this method is suitable for all sprays of high oil content, it is not so satisfactory for sprays of low oil content made with water of more than average hardness. A survey is in progress of methods suitable for abnormally hard water or where the quick breaking of the emulsion is required.

### 3. OVICIDAL PROPERTIES OF OIL SPRAYS.

By the use of the two-solution oleic acid method of emulsification, small-scale trials were carried out in collaboration with Mr. Jary and Mr. Austin of the action of

various tar, petroleum and vegetable oils on the eggs of the capsid *Lygus pabulinus* laid in currant twigs. Similar tests using the eggs of the winter moth *Cheimatobia brumata* were carried out by Mr. Duffield. Field-scale trials were made, in collaboration with Mr. Jary and Mr. Austin, of winter washes prepared from various tar oil and petroleum oil mixtures of known characteristics. The results of these trials, which showed that this method of emulsification is suitable for recommendation to those fruit growers who wish to make their own winter washes, are being prepared for publication.

#### 4. FUNGICIDAL PROPERTIES OF VEGETABLE OILS.

In collaboration with the Mycological Department, the investigation of the fungicidal properties of vegetable oils towards the hop powdery mildew has been continued. The season's work has shown that this property is common to all the glyceride oils tested, that it is inherent in the glyceride and is not due to adventitious material and that it appears to be greatly influenced by the manner of emulsification. Further work is needed to test this latter point. Field trials have been made to examine the action of these oils on the sulphur-shy varieties of apple and gooseberry which are now available in the College plantations. The survey, in collaboration with Professor Salmon, of the action of organic derivatives upon the hop powdery mildew has been continued, the compounds examined belonging mainly to the hydrocarbons and their hydroxyl derivatives, the alcohols and phenols. Promising results were obtained with certain naphthols and there is already evidence that the action of these compounds upon the mildew and the hop leaf is intimately related to their chemical structure.

#### 5. THE CHEMISTRY OF BORDEAUX MIXTURE.

The examination of the interaction of copper sulphate and calcium hydroxide solutions has been completed and an account of this work has been submitted for publication. As proof was obtained that the Bordeaux precipitate obtained by this reaction undergoes modification after spraying through the agency of carbon dioxide, the nature of this change and the method by which soluble copper, which has been detected in moisture collected from sprayed foliage, is formed are being investigated.

#### 6. THE COMBINATION OF CONTACT INSECTICIDES WITH COPPER-CONTAINING SPRAYS.

In response to enquiries from hop growers upon the possibility of combining nicotine with Bordeaux mixture, whereby the control of downy mildew and of aphid may be simplified, an investigation was begun of the problem of obtaining a satisfactory combination of contact insecticide with copper fungicides. One solution of the problem requires the use of a spreader, without which the efficiency of the contact insecticide is greatly reduced, and involves the general problem of the employment of spreaders with protective fungicides. As the spreading properties of soap are destroyed on addition to Bordeaux mixture by the excess lime present and it would seem that casein and gelatine, which have been used with Bordeaux mixture by other investigators, would interfere seriously with the formation of soluble copper after spraying, an important difficulty concerns the nature of the spreader used. The discovery that sulphite lye may be used with safety as a spreader solved this difficulty. It has, however, been generally accepted in this country that the addition of a spreader to Bordeaux mixture is unnecessary, for an adhesive Bordeaux deposit is obtained by the use of a fine misty spray and the avoidance of overspraying which may result in injury or in a Bordeaux film of inferior adhesiveness and protective power. It was therefore necessary to

determine whether, in the presence of sulphite lye, the use of a coarser spray, which appears to be needed if the insect pest is to be controlled, would give a Bordeaux deposit of satisfactory permanence. Field trials to examine this point and the insecticidal action of the mixture have been carried out, with the help of Mr. Austin, upon hop and potato. The results were good but trials repeated for several seasons are required before a definite recommendation may be made to the growers.

An alternative method of incorporating a contact insecticide with the protective fungicide is by means of an oil solution of the insecticide emulsified by means of Bordeaux mixture. This method was found satisfactory and field trials upon potato showed that the adhesiveness of the Bordeaux deposit was greatly increased by the presence of the oil. This phenomenon, which may prove of great importance in the use of protective fungicides and insecticides, is being investigated further, especially in relation to the work described under Section 2 above.

A third alternative is the use of an emulsion of an oil solution of a copper soap and the insecticide. An examination of the solubility of the copper soaps in cotton-seed oil suggested that the oleate might be suitable. Field trials upon potato and apple with emulsions of cotton-seed oil containing copper oleate gave unsatisfactory results, but a new copper soap has since been found which may be of sufficient solubility in the oil to answer this purpose.

#### 7. SPREADERS.

The need for additions to the list of materials which are used to confer spreading properties to spray fluids is illustrated by the difficulty mentioned above in the case of Bordeaux mixture. A number of materials likely to be of use for this purpose have been examined, the most promising of them so far has been sulphite lye. This material, which may be bought in concentrated form either as a viscous liquid or as a powder, is so cheap that its cost per 100 gallons of spray is below sixpence. Methods are, however, required for the estimation of its content of substances conferring spreading properties. A new process for preparing soap solutions in the field has been evolved whereby not only is the troublesome and expensive boiling-up process eliminated but the cost of material is below that of the soap required for an equivalent solution of soft soap. As both discoveries require further trial upon different crop plants and under different conditions, efforts are being made to persuade other workers to try out the materials, and a plea to this effect was made by the writer when he assisted Dr. R. M. Woodman to open a discussion on "The Use of Spreaders in Sprays" at the September meeting of the Wye Provincial Conference.

#### 8. PYRETHRUM.

One of the difficulties which has to be overcome before the growing of pyrethrum can be generally recommended is an economical method of harvesting the flower-heads. This difficulty was overcome last year, when the cultivation of the half-acre plot came temporarily under the supervision of this Department, by harvesting flower-heads and stalk. The market value of the dried product is, however, greatly reduced by the presence of stalk. With the assistance of Mr. A. G. Martin of the Engineering Department and of Mr. Austin, some appliances for stripping the flower-heads from the stalks were made and tested. A metal comb attachment was devised and by its use in the harvesting of the 1931 crop the cost of obtaining the flower-heads was reduced to about half that of hand-picking.

## PUBLICATIONS.

- (1) MARTIN, H. Chemistry and Plant Protection. *Nature*, CXXVI, 760, November, 1930.
- (2) *Idem.* The Examination of Tar and Mineral Oil Insecticides. *Jour. Soc. Chem. Ind.*, L., 91T-94T, March, 1931.
- (3) *Idem.* The Preparation of Oil Sprays. I. The Use of Oleic Acid as Emulsifier. *Jour. S.E. Agric. Coll.*, XXVIII, 181-187, July, 1931.

## DEPARTMENT OF ECONOMICS

By JAMES WYLLIE.

## I. INVESTIGATION INTO FARMING COSTS OF PRODUCTION AND FINANCIAL RESULTS.

This investigation was continued on the same basis as in the previous seven years. The general cost accounting method of investigation was in operation on seventeen farms while the results on other nine farms were under detailed investigation by means of a modified cost accounting method. Two more reports on the results of this investigation have now been published.

Report No. X deals with the results from *Sheep Breeding and Feeding* over the six years 1923-24 to 1928-29. Results are given from sheep husbandry on sixteen farms, covering sixty-one farming years between Michaelmas 1923 and Michaelmas 1929, showing an average loss per farm per annum of £91, equivalent to about 9½ per cent. per annum on the invested capital, before charging interest or managerial salary, whether these were actually paid or not.

On the average, the gross output, i.e. net sales of sheep plus sales of wool, formed only 51 per cent. of the capital invested. Of the total sales, about 87 per cent. consisted of sheep and 13 per cent. of wool. Of the total expenditure on sheep about 72 per cent. was for foodstuffs, 20 per cent. for labour and 8 per cent. for other items.

On the average, every £100 of gross output required an expenditure of £83 on foods, £27 on labour and £8 on other items, with the result that there was a loss of £18 on every £100 of gross output.

The results from six farms on which breeding flocks were kept to a certain extent on the fold and on other six farms on which breeding flocks were kept mainly or entirely on the pastures are given in detail. The results from the "folding" farms are very unsatisfactory, chiefly on account of the comparatively high feeding and labour costs. One of the most striking results is that on most of these farms the sheep would have shown a loss even if all the folding had been given to them for nothing.

The results from one farm are given separately under "Breeding" and "Fattening" and show a reasonable profit on the former compared with a heavy loss on the latter, the ewes in this case being kept chiefly on the pastures.

A marked feature of this six-year period is the number of changes which have been made either in respect of the number of sheep kept, the breed, the system of feeding or the general management.

Report No. XII gives the results from the 1924 to 1929 crops of *Potatoes, Mangels and other Root Crops*.

Over 660 acres of *potatoes* grown on ten farms the average net cost per acre was £34 9s. 5d., the average yield 6 tons 7 cwt., the average cost per ton of ware and seed £6 0s. 5d. and the average loss per acre £4 7s. 2d. Omitting the 1929 crops, the average loss per acre was £2 7s.

Of the ten farms, only one showed a profit, of 15s. 8d. per acre, while the other nine showed losses ranging from £2 3s. 7d. to £8 17s. 9d. per acre.

Over 588 acres of *mangels* grown on eighteen farms the average net cost per acre was £24 8s. 3d., the average yield about 26 tons per acre, and the average cost per ton about 18s. 9d.

Results are also given for cattle cabbage and for other root-crops—swedes, turnips, kale, etc.

The important part played by labour in the production of these crops is emphasised and the weakness of mangels and other root crops as economical cleaning crops is pointed out. The important conclusion is drawn that so long as the existing methods of cultivation are followed the scope for reducing the costs per acre is very limited while it does not seem that average yields, which depend so much on climatic conditions, can be very much increased.

The first of a proposed series of reports dealing in some detail with the *Financial Results on the College Farms* has also been published—Report No. XI.

In this report, a description is given of the general management of the College sheep flocks, the breeds kept and the changes that have been made during the four years 1926-27 and 1929-30.

During these four years the fattening sheep proved very unprofitable, the average loss amounting to about 24 per cent. per annum on the invested capital. The striking fact emerged that there would still have been a loss if the folded crops had been given free and the corn and cake charged at prices current in January, 1931. In consequence, the growing of folding crops and the fattening of sheep have been entirely abandoned, for the time being at least.

During these four years, flocks of Dorset Horn, Kent, Kerry Hill and Half-Bred (Border-Leicester x Cheviot) ewes were kept. 159 Dorset Horn fat lambs were sold, chiefly in the Easter Markets, at an average loss of 4s. 1d. per head and this flock has now been sold off. The average profit *per lamb* sold from the Half-Bred flock was 10s., from the Kent flock 9s., and from the Kerry Hill flock (two years only) 7s. 1d. The average number of lambs sold *per 100 ewes put to the ram* was 138 for the Half-Breds, 129 for the Kerry Hills, 105 for the Kents and 111 for the Dorset Horns, and hence the average profit *per ewe* was 13s. 9d. for the Half-Breds, compared with 9s. 1d. for the Kerry Hills and 9s. 5d. for the Kents.

Full details are given of the cost of labour, depreciation, etc., for each flock, and it is emphasised that the most important factor in financial success in sheep breeding under the College Farm conditions is the number of lambs sold per 100 ewes put to the ram.

Since the breeding flocks are kept entirely on pastures, reference is made to the kind of pastures, the system of manuring, stocking, etc. The introduction of two-year leys into the cropping schedule on the arable land is a matter of very general interest.

## 2. FOOD RECORDING SCHEME FOR DAIRY COWS.

As intimated in last year's report, a Food Recording Scheme was introduced on about forty milk-producing farms in Kent and Surrey in April, 1930, and is being worked in close co-operation with the County Agricultural Organisers—Messrs. G. H. Garrad and J. H. Mattinson. Complete returns up to Michaelmas, 1931, have been obtained from twenty-two farms in Surrey and twelve in Kent. The interest in the results shown

by the co-operating farmers has been remarkably keen. No report has yet been published, but it can be said that, besides being of immediate value from the point of view of economic milk production, the results open up a wide field for further investigation.

This scheme is directly under the charge of Mr. M. A. Knox.

### 3. LECTURES.

As in previous years, a course of lectures on agricultural economics has been given in the College to all Degree, Diploma and Certificate students, and a special course on Research Work in Farm Economics was given to Final Year Diploma students. The total number of lectures to students during session 1930-31 was 119.

A paper on "The Economics of Milk Production" was read before the Biennial Conference of County Agricultural Organisers at Cambridge.

Lectures to farmers were given at Redhill, Rye and Chobham (Mr. M. A. Knox). A lecture was also given at the Borden Farm Institute.

### 4. STAFF.

Mr. M. A. Knox has now been recognised as Permanent Assistant to the Advisory Economist and his status thereby improved. Mr. H. J. W. Powell, B.Sc.(Agric.), N.D.A., has been appointed as Junior Assistant.

### 5. GENERAL.

The Department co-operated in providing the College Educational Exhibit at the Kent County Show at Canterbury.

A number of enquiries on a variety of economic subjects have been dealt with and there has been an increasing correspondence from all over the country in connection with the reports on the investigations above mentioned.

### 6. PUBLICATIONS.

The following reports, etc., have been published during the year :—

WYLLIE, J. Investigation into Farming Costs of Production and Financial Results. *Report No. X.* Sheep Breeding and Feeding over Six Years (pp. 313-346).

WYLLIE, J. and HEWISON, N.V. Financial Results on the College Farms. *Report No. XI.* Sheep Breeding and Feeding over Four Years, 1926-27 to 1929-30 (pp. 1-35).

WYLLIE, J. Investigations into Farming Costs of Production and Financial Results. *Report No. XII.* Costs of Production and Financial Results for Potatoes and Root Crops, 1924 to 1929 (pp. 1-34).

WYLLIE, J. The Economics of Machine Milking. *Transactions of the Yorkshire Agric. Soc.*, 1931 (pp. 22-30).

WYLLIE, J. Successful Milk Production. *Jour. of the Brit. Dairy Farmers' Assoc.*, 1931 (pp. 35-41).

WYLLIE, J. Some Pointers in Farm Management. *Jour. S.E. Agric. Coll.*, 1931 (pp. 278-283).

WYLLIE, J. A Word for Cost Accounting. *Jour. of Proc. of the Agric. Econ. Soc.*, Vol. I, No. 3 (pp. 76-85).

KNOX, M. A. Some Sugar Beet Costs and Returns. *Jour. S.E. Agric. Coll.*, 1931 (pp. 131-136).

## VETERINARY DEPARTMENT

By A. D. McEWEN.

### "STRUCK."

During 1930, the sheep examined fell, with rare exceptions, into a large group all affected by the same disease. This disease was studied and has been described in the *Journal of Comparative Pathology and Therapeutics* for March, 1931, where, for this particular disease the popular name "struck" has been retained.

However, in 1930 one or two animals said by the shepherds to be "struck" were affected by a disease different from that generally encountered. These cases were rare and were characterised by an inflammation of the small intestine and by no other significant lesions. Whereas in 1930 this type of case appeared to be of little importance, in 1931 it was relatively of greater importance than any other acute disease termed "struck" by the shepherds, though again the actual number of cases was of little practical significance. The inflammation of the intestine, which has been mentioned, may vary very considerably in intensity, but it is sometimes very acute and violent, extensive hæmorrhage being present in the wall of the intestine and large quantities of blood being found in the lumen of the gut, where the contents consist principally of liquid blood. The disease as far as it is known occurs with little or no warning, the animal being found dead or dying. The acute disease is suggestive of a violent type of poisoning, but chemical analysis of the contents of the stomachs and intestines and of body organs has failed to show the presence of either mineral or alkaloid poison. Bacteriological examinations of the bodies of sheep have given negative results when the material examined was fresh, and bacteriological examinations of the contents of the alimentary tract so far have not resulted in suspicion being attached to the bacterial flora of the intestine as having any connection with the production of the lesions of the disease. Feeding healthy sheep with the stomach and intestinal contents and with the diseased intestine of affected animals has failed to produce disease, the experimentally treated animals remaining healthy. In a number of cases obtained at the time of death the contents of the alimentary tract have been tested for toxin. In one instance a heat labile toxin was found. This toxin upon intravenous inoculation of laboratory animals caused death in a few seconds to a few minutes. The toxin was not neutralised by the antitoxic serum of *B. welchii* or *B. paludis* which micro-organisms were thought most capable of producing such a toxin in the alimentary canal. The nature of this toxin was not ascertained; it is probably a bacterial toxin or a toxic product of protein disintegration caused by bacterial growth in the intestine, and whether it was responsible for the disease is not known. The results of the investigations are, therefore, negative in character. As but few cases have occurred, it has been difficult to make progress

Regarding the more serious form of "struck" which is a different disease, the work has been concerned mainly with methods of prophylactic inoculation. Preliminary experiments carried out on rabbits indicate that a satisfactory immunity may be produced by inoculating the animals with a filtrate of a broth culture where the filtrate originally showed a high toxic content and where this toxin has been modified by the action of formalin so that it is no longer noxious on inoculation into animals, even when large amounts are used.

To obtain good results and confer a high degree of immunity, it has been found necessary to employ two inoculations of large quantities of the modified toxin or "anatoxin." This would be a material disadvantage in field inoculations, and efforts have therefore been made (1) to concentrate the toxin before treatment with formalin, and (2) to concentrate the anatoxin after treatment with formalin in order to obtain a vaccine which would contain a sufficiency of anatoxin even though the vaccine should be small in volume.

During the early spring some 2,000 Romney Marsh sheep were vaccinated against "struck." On each farm a like number of control non-vaccinated sheep were kept. With the exception of 200 odd sheep, all of these animals were vaccinated by Mr. Roberts and myself. The greatest care was taken in making these inoculations, hands, syringes and needles being kept as sterile as possible. The sheep were vaccinated in the standing position, the inoculation being made into an area at the back of the shoulder after cleansing of the skin. This site was selected because of its cleanliness and because it did not come in contact with the ground. No sheep was upset by any of these inoculations.

One hundred and fifteen sheep which were not inoculated by Mr. Roberts or myself were vaccinated without the strict observance of the precautions outlined above. Fifteen per cent. of these sheep died from "gangrene" as a direct result of the inoculations. Material from five of these sheep was examined, and in four cases *B. chauvoei*, the bacterium which is the cause of "gangrene," was the causal micro-organism of the animals' death. These bacteria present in the soil or on the skin of the animal had been carried into the body with the inoculation and had caused death. There is no doubt that had greater precautions been taken in making the inoculations, these fatalities would not have occurred.

An experience of this nature makes it very doubtful if, in the event of methods of vaccination against "struck" and "gangrene" becoming scientifically established, it would be safe to allow the farmers and shepherds themselves to give the vaccine. No other manner of giving the inoculations would be an economic proposition. It is probable that it is only on the Romney Marsh where this inoculation risk exists.

No positive information regarding the value of vaccination was obtained by the field experiments because of the scarcity of cases last year. For all practical purposes the disease was not present, and this rendered field investigations sterile.

#### "GANGRENE."

From a detailed study of the bacteriology of cases of "gangrene" encountered during the past two seasons, it appears that in the very great majority of cases the micro-organism responsible for the disease is *B. chauvoei* and that immunological methods of prevention should be directed against this bacterium. These researches have been published in the *Journal of Comparative Pathology and Therapeutics* for September, 1931.

An effective immunity to *B. chauvoei* infection is readily produced by vaccination. If it were possible to confer protection against both "struck" and "gangrene" by one simultaneous inoculation of vaccine for both diseases, it would be of considerable economic value. Experiments have been designed to ascertain if by combining the two vaccines an effective immunity response would be stimulated to each. Work on laboratory

animals shows that the efficacy of "struck" vaccine is thereby not lost. Whether as effective a response is elicited to the "gangrene" vaccine has still to be ascertained.

Although vaccination against "gangrene" caused by *B. chauvoei* is of assured value, yet on account of the irregularity with which the disease appears in a flock, it is doubtful if a vaccine would be used generally. This may be one of those paradoxical instances where twice or three times as many losses would stimulate the farmer to adopt methods of effective protection, whereas now they may prefer to run the risk of a moderate loss, rather than take the trouble to vaccinate.

It is very generally agreed that those ewes which have received assistance at lambing are the animals most likely to contract the disease. If it were possible to protect these animals, it would appeal to the shepherd or farmer and the method would be used on these selected cases. With this end in view, a *B. chauvoei* antiserum was prepared from a horse. The inoculations and bleedings had to be made at Amage (one of the farms of the South-Eastern Agricultural College) under very bad conditions. A serum of high potency was obtained. This was distributed along with syringes, etc., to a number of shepherds and was inoculated into ewes which the shepherd from his experience would have expected to contract "gangrene." The serum was favourably reported on. No reliance whatsoever should be placed on these reports. Nevertheless, exact experiments carried out under controlled laboratory conditions encourage the belief that serum will be of material benefit when used in such cases as those described above.

#### CONTAGIOUS ABORTION.

Work on the eradication of this disease has been progressively carried out on a number of herds and the results have been encouraging.

For the success of the eradication policy it is necessary to receive the enlightened co-operation of the farmer, and he must be instructed in all aspects of the disease affecting the animals and encouraged along the soundest though not the easiest course. Where enlightened co-operation has been established the eradication policy appears to have been most successful, and with certain herds it is now a question of keeping the infection out of the herd and not a question of getting rid of or isolating infected animals. Each herd presents its own individual problems as to management, etc., whilst an effort is being made to eradicate it of infected animals and of infection.

Cases of abortion not caused by *B. abortus*, and therefore not cases of "contagious abortion," have occurred on a number of farms. In a considerable number of cases the aborted foetus has been obtained but the foetal tissues have invariably been found sterile. No bacterial infection would appear to be implicated in these cases. At present no cause nor probable cause can be assigned to these non-infectious types of abortion.

The eradication policy for the control of contagious abortion does not sound easy and it requires patience and perseverance. For these reasons it is not acceptable to many individuals.

Advisory work has been concerned chiefly with sheep and poultry diseases. Eight lectures were delivered by Mr. Roberts and myself to farmers in the Province.

The Department is very indebted to Mr. N. V. Hewison for his unfailing kindness and help in housing and caring for the larger experimental animals. Without his help the work could not have been done. I wish to express my sincere thanks to Mr. Hewison.

## PUBLICATIONS.

1. McEWEN, A. D. and ROBERTS, R. S. "Struck" Enteritis and Peritonitis of Sheep caused by a Bacterial Toxin derived from the Alimentary Canal. *J. Comp. Path. and Therap.*, 1931, 44, 26.
2. McEWEN, A. D. A Sporulating Anaerobic Bacillus, similar to the causal organism of Black Disease. *J. Comp. Path. and Therap.*, 1931, 44, 149.
3. ROBERTS, R. S. and McEWEN, A. D. Gas Gangrene Infection of Sheep. *J. Comp. Path. and Therap.*, 1931, 44, 180.
4. McEWEN, A. D. Contagious Abortion and its Control. *J. Kent Farmers' Union*, March, 1931.
5. ROBERTS, R. S. Diseases of Sheep caused by Parasitic Worms. *J. Kent Farmers' Union*, June, 1931.
6. McEWEN, A. D. Summary of Preliminary Investigations on "Struck," an acute Disease of Sheep. *Jour. S.E. Agric. Coll.*, 1931, 216.

## DAIRY BACTERIOLOGICAL ADVISORY SERVICE

By H. BARKWORTH.

### I. CLEAN MILK COMPETITIONS.

The year under review again saw a Clean Milk Competition organised in each of the four counties comprising the Province. The total number of competitors was the highest yet reached. The competitions in Surrey and West Sussex were according to the Ministry of Agriculture's scheme, and the Kent competition was on similar lines but was planned for nine months instead of six.

Unfortunately the East Sussex competition, which does not finish till December, 1931, has been cut by 25 per cent. and will finally close with only six samples per herd. Four samples were taken in the period March-June, and two further samples will be taken from each competitor after October 1st.

*Totals for 1930-31.*

							<i>No. of Competitors.</i>	<i>No. of Samples.</i>
Kent	..	..	..	..	..	..	36	453
Surrey	..	..	..	..	..	..	54	488
West Sussex	..	..	..	..	..	..	21	189
East Sussex (unfinished)	..	..	..	..	..	..	78	295
							<hr/> 189	<hr/> 1,425

### 2. ADVISORY WORK ARISING FROM COMPETITIONS.

It is exceptional for competitions to bring in any special work. Two cases of mastitis and two queries on keeping quality were dealt with from the laboratory and seventeen samples from ten different herds were tested for County Staffs.

The laboratory can be much more than a counting machine, and competitions should result in a closer collaboration between producers and the laboratory.

### 3. PRIVATE SAMPLES.

The financial aspect for the season is slightly better than it was last year, but there are *very few regular senders*. Dairies again send in a high proportion of samples and there has been an increase in the amount of work done for Public Health Authorities. A number of samples were tested for East Sussex and have been included in this section.

The laboratory will seek the co-operation of County Staffs in a fresh effort to increase the number of private senders and to expand still further the work done for Public Authorities and dairies.

*Private Samples.*

						<i>Senders.</i>	<i>Totals.</i>	
							1930-31	1929-30
Producers in Kent (one sender totalled 63)	..	..	..	..	..	21	127	—
„ „ Surrey (one sender totalled 13)	..	..	..	..	..	14	45	—
„ „ West Sussex .. .. .	..	..	..	..	..	5	21	—
„ „ East Sussex (two senders totalled 28)	..	..	..	..	..	9	57	—
							<hr/>	<hr/>
							250	206
Dairies .. .. .	..	..	..	..	..		159	165
Public Health (East Sussex County Council 34)	..	..	..	..	..		173	25
Reading of Duplicate Scheme .. .. .	..	..	..	..	..		132	116
Advisory (all classes) .. .. .	..	..	..	..	..		116	94
							<hr/>	<hr/>
Grand Total .. .. .	..	..	..	..	..		830	606
							<hr/>	<hr/>

Several dairies and producers were visited, but no case of special interest arose. Fourteen samples from eight herds were tested for mastitis, eight water analyses were made for two herds.

In one case the marked taint in the milk as sold was found to be due to the indiscriminate use of iodoform pessaries.

Two cases were referred to County Staffs and applications for licences were made by two herds seeking a licence for "Certified Milk" and one for "Grade 'A' (T.T.) Milk." Apart from Local Authorities only one test was made for tuberculosis.

#### 4. ADVISORY VISITS.

Every endeavour is made to establish and maintain personal contact with senders. The necessity for an advisory visit is made the opportunity to visit other senders in the neighbourhood. Under this policy the Bacteriologist was absent from the laboratory on thirty-five days and made thirty-two advisory visits. Additional second visits were made in three cases and twenty-eight calls were made on various senders and County Staffs. Five cases were dealt with by letter.

#### 5. SHOWS.

Exhibits were staged at the Kent County Agricultural Show, the Tunbridge Wells Show and the Kent Rural Community Council County Fair. Material for exhibits was also supplied to East and West Sussex.

#### 6. LECTURES.

The Bacteriologist was asked to contribute two lectures to a course organised for Prospective Sanitary Inspectors, and also gave one lecture at Brighton as part of a series organised for Dairymen by the East Sussex County Council.

## 7. CONFERENCES.

It is often possible for a single journey to include more than one of these annual events in the dairy life of the country, and the meetings attended during the year were :

1. Dairy Show and Dairy Instructors' Conference.
2. Winter Meeting A.E.A.
3. Dairy and Ice Cream Convention.
4. Summer Meeting A.E.A. and Dairy Bacteriologists' Conference.
5. Agricultural Bacteriologists' Conference.

A paper on Keeping Quality, postponed from the winter meeting, was read at the Summer Meeting of the Dairy Additional Committee of the A.E.A., and a paper on Sterilisation was read at the meeting of Agricultural Bacteriologists.

## 8. RESEARCH.

*Van Oyen's Test.* The Governors of the College having generously made a grant, a visit was made to Professor Van Oyen at Utrecht, apparatus purchased, and an investigation commenced into Van Oyen's modification of Frost's Little Plate method, being a rapid method for obtaining accurate "counts" of milk samples. Illness severely hindered progress at the most favourable time, but sixty-one duplicate tests have been made.

*Keeping Quality.* After accumulating data for seven years it was decided to publish the results ; the scientific papers were ready in 1930, and the detailed reports were published in the *Journal* in July, 1931 ; these were preceded by a summary in 1930.

## 9. INCIDENCE OF WORK.

	<i>Expected Total</i> 1930-31.	<i>Jan. 1st-June 30th, 1931.</i>	
	<i>No. of</i> <i>Samples.</i>	<i>No. of</i> <i>Samples.</i>	<i>Percentage</i> <i>of Total.</i>
Competitions* .. ..	1,670	1,300	77%
All other sources .. ..	830	400	48%
Total for year .. ..	2,500	1,700	68%

\* Including East Sussex samples yet to come.

*Rate per Week.*

Average rate for period Jan. 1st-June 30th	= 65 samples per week.
Average rate for rest of year	= 32 " " "
Taken over whole year	= 48 " " "

Actually the advisory and general work has been spread fairly evenly over the year and the competition work is seasonal. Two-thirds of the work has to be done in half the year and at the same time the Bacteriologist must be able to leave the laboratory bench as and when required.

If incidence were regular the laboratory would be able to deal with one hundred samples per week.

## 10. PUBLICATIONS.

BARKWORTH, H., November, 1930. The Influence of the Fat-Content on the Keeping Quality of Milk. *Jour. Min. Agric.*, XXXVII, No. 8, pp. 803-806, with one table and one figure.

*Idem*, July, 1931. Keeping Quality of Milk and the Age on Testing for Total Bacterial Count. *Jour. Hygiene*, XXXI, No. 3, pp. 373-374.

*Idem*, July, 1931. The Keeping Quality of Afternoon Milk. *Jour. S.E. Agric. Coll.*, No. 28, pp. 270-272.

*Idem*, July, 1931. Normal Variations of Keeping Quality. *Jour. S.E. Agric. Coll.*, No. 28, pp. 273-277.

*Idem*, August, 1931. True Time required for Sterilisation. *Zent. f. Bakt.*, II. Abt. Bd. 84, Nr. 15/18, pp. 353-357.

## AGRICULTURAL DEPARTMENT

By V. R. S. VICKERS, V. C. FISHWICK, H. B. BESCOBY and N. L. TINLEY.

### FIELD TRIALS AND EXPERIMENTS.

#### 1. BARLEY MANURING (carried out at the request of Sir John Russell, F.R.S.).

Plots designed in the form of a 4 by 4 Latin square, giving 16 plots each of  $\frac{1}{16}$ th acre. Each of the 16 plots subdivided into 4 plots of  $\frac{1}{64}$ th acre. A total of 64 plots in a complex Latin square.

*Series A.* To test the effect of nitrogenous manures.

Plot 1. \*106 lbs. of sulphate of ammonia per acre.

„ 2. \*165 lbs. of nitrate of soda „ „

„ 3. \*128 lbs. of calcium cyanamide „ „

„ 4. No nitrogen.

\* Nitrogen equivalent to .2 cwts. per acre.

*Series B.* To test the effect of superphosphate.

Plot 1. †250 lbs. superphosphate per acre.

„ 2. No superphosphate.

† .4 cwts.  $P_2O_5$  per acre.

*Series C.* To test the effect of sulphate of potash.

Plot 1. ‡150 lbs. of sulphate of potash per acre.

„ 2. No sulphate of potash.

‡ .6 cwts.  $K_2O$  per acre.

During growth the nitrate of soda plots were the greenest and best, the no nitrogen plots were thin and the straw short. The harvesting was carried out by a sampling method, nine small samples being cut and collected on each  $\frac{1}{16}$ th acre plot. These samples have been forwarded to Rothamsted Experimental Station to be threshed, and for the nitrogen content of the grain to be determined.

First year of the trial.

#### 2. POTATO VARIETIES.

Plots  $\frac{1}{16}$ th acre designed in a double Latin square with 8 replications for each variety.

Plot 1. Arran Consul.

„ 2. Arran Banner.

„ 3. Seedling 675.

„ 4. King Edward.

In the season 1929-30 several varieties were given a preliminary trial and the three heaviest yielding varieties have been tested in 1930-31 with King Edward as a

control. Arran Consul have again given the highest yield and King Edward the lowest. From cooking tests the Arran Banner gave better results than Arran Consul or Seedling 675.

<i>Results.</i>						<i>Tons per acre.</i>
Plot 1.	Arran Consul	..	..	..	..	12.30
„ 2.	Arran Banner	..	..	..	..	10.74
„ 3.	Seedling 675	..	..	..	..	10.48
„ 4.	King Edward	..	..	..	..	8.06
Significant difference						.48

Second year of the trial.

### 3. SUGAR BEET. (At the request of Sir John Russell, F.R.S.)

Plots  $\frac{1}{16}$ th acre in a 4 by 4 Latin square.

Variety Kleinwanzleben.

*Series A.* To test the effect of nitrogenous manures.

Basal dressing.

12 tons farmyard manure per acre.

4 cwts. superphosphate „ „

2 cwts. muriate of potash „ „

Plot 1. \*186 lbs. sulphate of ammonia per acre.

„ 2. \*288 lbs. nitrate of soda „ „

„ 3. 224 lbs. calcium cyanamide „ „

„ 4. No nitrogen.

\* Nitrogen equivalent to 2 cwts. of calcium cyanamide.

*Series B.* To test the effect of muriate of potash and salt.

Basal dressing.

12 tons farmyard manure per acre.

4 cwts. superphosphate „ „

2 cwts. sulphate of ammonia „ „

Plot 1. † 160 lbs. salt per acre.

„ 2. 224 lbs. muriate of potash per acre.

„ 3. 224 lbs. muriate of potash + 160 lbs. salt per acre.

„ 4. No salt or muriate of potash.

† Chloride equivalent to 224 lbs. muriate of potash.

First year of the trial.

### 4. MANGEL MANURING.

*Series A.* To test the effect of salt and muriate of potash.

Plots  $\frac{1}{16}$ th acre in a 4 by 4 Latin Square.

Basal dressing.

12 tons farmyard manure per acre.

1 cwt. sulphate of ammonia „ „

2 cwts. muriate of potash „ „

1 cwt. steamed bone flour „ „

- Plot 1.  $\frac{1}{2}$  cwt. muriate of potash per acre.  
 „ 2. 1 cwt. muriate of potash „ „  
 „ 3. 160 lbs. salt „ „  
 „ 4. No muriate of potash or salt.

First year of the trial.

*Series B.* To test the effect of top dressing with nitrogenous manures.

Plots  $\frac{1}{4}$ th acre in a 4 by 4 Latin square.

Basal dressing.

- |                            |           |
|----------------------------|-----------|
| 12 tons farmyard manure    | per acre. |
| 1 cwt. sulphate of ammonia | „ „       |
| 2 cwts. muriate of potash  | „ „       |
| 1 cwt. steamed bone flour  | „ „       |
- Plot 1. 1 cwt. sulphate of ammonia per acre.  
 „ 2. 148 lbs. nitrate of soda „ „  
 „ 3.  $\left\{ \begin{array}{l} 56 \text{ lbs. sulphate of ammonia} \\ 64 \text{ lbs. nitrate of soda} \end{array} \right.$  „ „  
 „ 4. No nitrogen.

First year of the trial.

#### 5. GRASSLAND MANURING.

Observations on the improvement of the herbage by the use of basic slag in Long Brook were continued. Section I of the field has received two dressings of 10 cwts. of basic slag, one in 1926 and the other in 1930. Section II, 6 cwts. North African phosphate in 1926 and 10 cwts. basic slag in 1930. Section III, North African phosphate in 1926.

The basic slag has improved the growth of the grasses and clovers.

#### 6. PASTURE INVESTIGATIONS. BREZZETT. (At the request of the Pasture Investigation Sub-Committee.)

These investigations have been carried out since 1928, but during the season 1930-31 sulphate of ammonia has been applied every six weeks instead of three-weekly intervals in previous years. The increased weight on the sulphate of ammonia plot has been considerably reduced. The samples of grass cut have been dried and will be forwarded to the Rowett Institute for analysis.

#### 7. PERMANENT GRASS MIXTURES.

The plots were sown in 1925 and a herbage analysis has been carried out by the Department of Botany during the summer of 1931 as in previous years. The grazing on all the plots has been even and the plots appear to be becoming more uniform.

#### WOOL INVESTIGATION.

An investigation into the Economy of Washing Sheep has been carried out during the year. The results were obtained from a study of the books of the Kent Wool-growers Ltd., from which was obtained the average weight of 300,000 washed and

unwashed Kent fleeces between the years 1924 and 1929. The loss in weight due to washing was thus obtained, and from this the respective values of washed and unwashed fleeces were calculated.

The result shows that, contrary to general opinion, there is a profit in favour of washing after paying the expenses. This profit, however, is small, amounting to approximately 2½d. per fleece.

It is interesting to note that of the small quantity of the 1930 clip which has so far been sold by the Kent Woolgrowers, the greater part has been washed, showing the better marketability of the washed wool. In spite of the present low price of wool, there is still a balance in favour of washing.

The growth and quality of wool is influenced by soil climate, feeding and the breeding of the sheep. A survey of the Kent breed of sheep was begun in November, 1930, to try to determine the influence of these factors on the Kent wool.

Two hundred letters, accompanied by a questionnaire, were sent out to breeders of Kent sheep. The excellent number of 142 replies was received with the questionnaire completed. The information gained from these replies has been incorporated in an article on Kent sheep (to be published shortly), and it is hoped that further useful data may be obtained.

### SHEEP FEEDING EXPERIMENT.

Results in Australia, obtained by the Division of Animal Nutrition, have shown that the growth of wool can be increased in weight if a concentrated form of protein is fed to the sheep.

The material actually used was dried Blood Meal. An experiment with the same feeding stuff is being carried out on the College Farm with two flocks of forty Half-Bred ewes to ascertain the effect on the growth and quality of wool in this country.

### PIG HUSBANDRY RESEARCH SCHEME.

#### I. A COMPARISON OF THE OUT-DOOR AND SEMI-INDOOR SYSTEMS OF REARING BREEDING STOCK.

In the last report a trial was recorded in which a batch of gilts was divided into two groups. One of these groups was reared on the open-air system, the other was housed in the buildings and turned out to graze during the day whenever the conditions were favourable. No differences could be detected in the growth of the gilts, nor in their progeny.

The trial was repeated during the year 1930-31, a similar result being obtained.

#### 2. THE FEEDING AND MANAGEMENT OF BREEDING STOCK.

The problem is being studied in three sections, viz. the feeding and management of (a) the pregnant sow, (b) the nursing sow, (c) the sucking pig. These sections must be studied separately, although they react upon one another.

The work in Sections (a) and (c) recorded in the last report has been continued.

*The Feeding of In-pig Sows.* Prior to 1930 it was conventional to recommend the use of rations containing 14 to 15 per cent. of protein, the high protein content being obtained by the use of 10 per cent. of fish meal (or a similar food). In the 1930 report it was recorded that satisfactory results had been obtained during the year 1929-30 with rations containing 12 per cent. of protein when little or no grazing was available, and with rations containing 10 to 11 per cent. when the sows could obtain plenty of grass. The reduction in protein content was effected by reducing the fish meal from 10 per cent. to 5 per cent. in the former and omitting it altogether in the latter rations.

During the year 1930-31 excellent results have again been obtained from the use of rations with the lower protein content. The work is fully described in two papers, numbered (1) and (3) in list below.

*The Feeding of Sucking Pigs.* The method of feeding outlined in the 1929-30 report was followed throughout the year with very satisfactory results. Pea meal has been used to replace linseed cake meal in the ration. The mixture used during 1930-31 was 45 per cent. sharps, 45 per cent. barley meal, 10 per cent. pea meal. The latter appears to be equally satisfactory and more economical than the linseed mixture used in the previous year, which is very sticky and tends to adhere to the faces of the pigs and to the utensils, so causing unnecessary waste.

*Outdoor v. Indoor Systems of Management.* The work in this section has been continued. Two experiments were carried out during the year. The first with the September (1930) litters and the second with the March (1931) litters. Similar results were obtained in the two experiments. They indicate that it is easier to rear young pigs which are allowed to run out on grass than those confined to styes. The former make more rapid growth and suffer less from digestive troubles than the latter. It was observed that whereas young pigs which run out on grass start to eat at about a month old, those confined to styes do not as a rule start until they are five weeks old. A full account of these experiments is given in a paper (7) which will appear shortly.

All the pigs from the autumn litters received a vermifuge. The outdoor reared pigs were found to be heavily infested with worms, none of these parasites were found in those reared indoors. The Department of Veterinary Research pointed out that American experimenters had evolved a method of controlling these parasites (the Maclean County System). Particulars of this system were obtained but it was found to be impracticable under English conditions. A system of management based upon the Maclean System is being evolved which is suitable to conditions in this country. The results obtained to date are highly satisfactory. The main points in this system are : (1) The farrowing runs are only used for sows and their litters and the young pigs after weaning ; (2) The runs are moved on to fresh ground periodically ; (3) The older pigs (pregnant sows and growing gilts) are run in conjunction with other stock so that the land is lightly stocked with pigs, i.e. not more than two pigs per acre.

### 3. FEEDING EXPERIMENTS WITH FATTENING PIGS.

*Wheat Meal as a Substitute for Millers' Offals.* Numerous enquiries have been received regarding the possibility of using home-ground wheat meal for pigs instead of buying middlings. An experiment was carried out with fattening pigs in the winter 1930-31 in which satisfactory results were obtained by replacing the middlings in the standard rations by a mixture of wheat meal and bran. The rations fed were :—

			40-90 lbs. live weight.		90-130 lbs. live weight.	
			Lot 1.	Lot 2.	Lot 1.	Lot 2.
Barley Meal	..	..	50	50	62½	62½
Wheat Meal	..	..		30		20
Bran	..	..		10		10
Middlings	..	..	40		30	
Soya Bean Meal	..	..	10	10	7½	7½

1½ lbs. chalk and ¼ lb. salt were added per 100 lbs. of mixed meal.

The amounts of meal consumed per lb. live weight increase were (Lot 1) 3.77 lbs., (Lot 2) 3.78 lbs. Thanks to the kind co-operation of Mr. J. Guy, Pork Butcher, of Ashford, it was possible to examine the carcasses. No difference could be detected in those from the two groups. An article (6) giving full details of this experiment has been published.

*The Proportion of Middlings in the Rations of Fattening Pigs.* If the wheat quota system is adopted the output of middlings in this country will be increased. It is thus desirable to ascertain what is the maximum extent to which this food can be profitably employed. The first of a series of experiments designed to throw light upon this point was carried out during the summer months. The experiment was started on May 21st : from that date until August 13th (twelve weeks) the pigs were kept in grass runs. On the latter date they were transferred to styres where they remained until ready for market. The following table gives a summary of the results :—

#### Rations.

			Lot 1. per cent.	Lot 2. per cent.	Lot 3. per cent.	Lot 4. per cent.
Middlings	..	..	30	45	30	60
Barley Meal	..	..	60	45	60	30
Soya Bean Meal	..	..	10	10	10	10

1½ lbs. chalk and ¼ lb. salt were added to each 100 lbs. of mixed meal.

#### Average Weights.

			Lot 1. lbs.	Lot 2. lbs.	Lot 3. lbs.	Lot 4. lbs.
At the beginning	..	..	44	44	38	37
At end	..	..	188	186	183	176
Increase	..	..	144	142	145	139
Meal consumed per 1 lb. live weight increase	..	..	3.7	3.9	3.6	3.9

In the carcasses no difference could be detected which could be correlated with the differences in feeding. A preliminary paper (5) on this subject has been published.

The writer has again to acknowledge the receipt of help and advice from the Department of Veterinary Research on several occasions during the year.

## PUBLICATIONS.

- (1) FISHWICK, V. C., 1930. Rations for In-pig Sows. *Jour. Min. Agric.*, October, 1930.
- (2) *Idem*, 1931. Wheat Meal as a Pig Food. *Farmer and Stockbreeder*, 23, February, 1931.
- (3) *Idem*, 1931. Feeding and Management of Breeding Pigs. *Agricultural Progress*, 8, 1931.
- (4) *Idem*, 1931. Open-air or Sty Feeding of Sucking Pigs. *Farmer and Stockbreeder*, 29th June, 1931.
- (5) *Idem*, 1931. Middlings in Pig Mixtures. *Farmer and Stockbreeder*, 12, October, 1931.
- (6) *Idem*, 1931. Wheat Meal v. Millers' Offals. *Jour. Min. Agric.*, November, 1931.
- (7) *Idem*. Rearing Sucking Pigs. The Value of a Run on Grass. *Jour. Min. Agric.* (In the Press.)
- (8) TINLEY, N. L. The Economy of Washing Kent Sheep before Shearing. *Jour. Min. Agric.*, May, 1931.

## BOTANICAL DEPARTMENT

By S. T. PARKINSON, R. T. PEARL and R. M. HARRISON.

### ADVISORY WORK.

Inquiries continue to centre round grassland work and the prevention of weeds. A few samples of cattle foods have been examined.

### CEREALS.

Mr. Harrison is preparing a report, for publication, of the statistical examination of the Yeoman wheat plots.

Mr. F. H. Foster has undertaken observations on the effect of top-dressing Yeoman wheat with sulphate of ammonia at different times of the year. Fifty-four plots are involved. Dressings of approximately  $1\frac{1}{2}$  cwt. per acre were applied in January, March and May. The manuring was randomised and eighteen plots were manured at each dressing. Notes on the progress and appearance of the plots were made at intervals and tiller counts and measurements of length of straw and ear carried out. The plots were harvested in August and the weight of straw and grain recorded for each plot.

Messrs. T. H. Morrish and F. L. Jezzi observed the growth of Rivett wheat planted on consolidated and loose soil respectively. No definite conclusions can be drawn, as only six small plots were sown down, but an interesting point noticed was that, although a slightly greater yield of both straw and grain occurred in the consolidated soil, the weight of 1,000 grains from the loose soil was greater than from the consolidated.

Messrs. D. D. Sharma and A. J. Thompson continued the precision records in connection with the Agricultural Meteorological Scheme. Although conditions were bad, the plots were harvested and samples sent to Rothamsted according to instructions.

### FOODSTUFFS.

Messrs. Bolton and Peters are, at present, investigating the microscopic character of fragments of weeds belonging to the *Polygonaceae* which are liable to occur in cattle cake.

### GRASSLAND.

Observations were continued on the thirty permanent plots in Brook Field. A full report for 1929-30 was sent to the Agricultural Department. The remarks contained in last year's report continue to hold good but, on the whole, the plots are tending more and more to uniformity in character.

*Cyanamide Dressings.* The experiment carried on with the co-operation of Mr. K. A. Latter of Weald Place, Sevenoaks, was continued. Except for a temporary stimulus, no permanent botanical difference was discovered between the plots with autumn and spring dressings. Yellow Rattle has practically disappeared from the area. There seems no reason to continue this work.

### PHENOLOGICAL GARDEN.

Observations have been continued and a report sent to the Ministry of Agriculture.

### SYSTEMATIC POMOLOGY.

During the past five years Mr. R. T. Pearl has made a study of the characteristics of about sixty apple varieties at flowering time. The results are embodied in a paper to be published shortly. An historical survey of the subject is followed by a detailed consideration and description of the various morphological characters of the inflorescence. The uniformity and the constancy of individual characters are dealt with and their value in the diagnosis of varieties is considered. General descriptions, supplemented by full details in the form of comparative tables, are made of about twenty-five well-known varieties.

Observations, principally on the winter and summer wood-shoot characters, of a number of apple varieties have been continued and extended. The recognition of varietal differences, during the winter season, is important in pruning and in propagation work; but this is undoubtedly the season of the year during which naming of the variety is most difficult and uncertain. The range of varietal difference is comparatively limited, and a good deal of individual tree variation may also be encountered.

### WYE PROVINCIAL CONFERENCE.

In March 1930, Mr. R. T. Pearl was appointed convener of the Horticultural Section of the Wye Provincial Conference. The Conference meets quarterly for whole-day discussions of important horticultural problems. These discussions are opened by members of the Conference or by prominent outside authorities. The convener is responsible for the arrangements and for the preparation of a full report of the proceedings.

### WEED SURVEY.

A weed survey is being carried out on the farm under the direction of Mr. R. M. Harrison. Several students have shown keenness in assisting in this scheme. Certain results obtained have already been published.

### PUBLICATIONS.

- N. K. GREEN, J. R. MOFFATT and S. T. PARKINSON. Identification of Common Species of Pea and Bean Seeds. *Jour. S.E. Agric. Coll.*, No. 28, 1931, pp. 29-40.
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## ENGINEERING DEPARTMENT

By CORNELIUS DAVIES.

### POWER FARMING CONFERENCE.

At a conference held on April 22nd, Sir Walter W. Berry, K.B.E., J.P., and the Hon. W. E. C. James presiding, the following papers were read: "Farm Mechanisation for Cereal Production and a Suggested Wheat Policy arising therefrom" by R. Dudley, Esq., A.M.I.C.E.; "Mechanisation in Mixed Farming" by D. R. Bomford, Esq., and "The Utilisation of Power in Milk Production and Arable Farming" by A. J. Hosier, Esq.

### MINISTRY OF AGRICULTURE MACHINERY ADVISORY COMMITTEE.

The Head of the Department attended all (nine) meetings of the above Committee, as well as a special demonstration of new machinery arranged for members of the Committee at Rothamsted.

### SOIL CULTIVATION EXPERIMENTS.

The series of experiments designed to investigate the effects of different tilths and of consolidation upon cereal growth and yield have been repeated. The plots, which were all arranged in randomised blocks, were upon Wye Loam. Barley was grown, sown at the rate of 3 bushels per acre on March 24th, and a dressing of 4 parts super., 1 mur. pot., 1 S/A and 1 S.B.F. was applied before March 16th, the date of drilling. As before the plots were prepared and sown both in the autumn and in the spring.

#### *Results.*

*All the Yields are given in cwt. per acre.*

#### Set I. HAND DUG. AUTUMN. 8 Replicates.

				Coarse (spade)	Fine (fork).	Coarse and consolidated.	Fine and consolidated.
Grain	..	..	..	18.39	19.08	17.76	21.36
Straw	..	..	..	24.65	24.2	25.38	24.73

The differences are not significant. These plots were sown with oats on November 12th, but were ruined by birds. They were resown with barley on March 24th. Some of the original oats, not completely eradicated, ripened before the barley and attracted birds, which caused the mean yield of all the plots to be reduced.

#### Set I. HAND DUG. SPRING. 8 Replicates.

				Coarse (spade).	Fine (fork).	Coarse and consolidated.	Fine and consolidated.
Grain	..	..	..	23	21.68	21.58	20.7
Straw	..	..	..	21.58	21.7	20.15	20

The differences are not significant.

Consolidation readings were taken at thirty-day intervals, and they were greater on the consolidated plots throughout. Tiller counts and moisture content were also noted at regular intervals but there was nothing of note in the records to which to call attention.

This set of experiments has thus given negative results for two consecutive years, despite the fact that definite under-surface consolidation was obtained and maintained throughout the growing periods.

## Set II. TILTHS PREPARED WITH FOUR DIFFERENT IMPLEMENTS AND MACHINES.

G.P.—General Purpose plough ; Dig.—Digger plough ; Pul.—Pulverator plough ; Sim.—Simar Rototiller.

### Results.

#### AUTUMN. 7 Replicates.

	G.P.	Pul.	Sim.	Dig.	General mean.	Standard error.	Significant difference
Grain .. ..	17.3	15.2	13.38	15.7	17.19	.812	1.77
Straw .. ..	26.3	24.75	27.56	26.1	—	—	—

The General Purpose plough showed a significantly higher yield than the Pulverator and the Simar, and the Digger was higher than the Simar. These plots were damaged in the same way as Set I Autumn, and it was therefore impossible to see whether the remarkable tillering, noted during the 1929-30 season, was present on the fine Simar plots.

#### Set II. SPRING. 7 Replicates.

	G.P.	Pul.	Sim.	Dig.	General mean.	Standard error.	Significant difference.
Grain .. ..	24.44	23.15	21	23.64	23.14	.508	1.127
Straw .. ..	24.7	21.9	22.25	23.33	—	—	—

The General Purpose plough treatment resulted in a significantly higher yield than that of the Pulverator and the Simar, and the Digger was better than the Simar. All these results agree in the main with the 1929-30 experiments in that the very fine tilths produced by the Simar and, to a lesser extent, by the Pulverator, appear unsuitable for cereals *on the soils used* and during the seasons under review. Tiller counts, consolidation readings and moisture content were recorded throughout the growing season.

The residual effects of last year's cultivations upon the next crop—mangels—show no significant differences. Thirty 6-foot samples were taken at random from each treatment :

#### Mean yield per sample, in lbs.

G.P.	Pul.	Sim.	Dig.
16.15	17.82	17.3	18.25

## CONSOLIDATION BY TRACTOR.

During May there appeared to be parallel lines of stronger growth in the barley adjoining the experimental area, also on Wye Loam, and it was established that these lines were made by the tractor wheels during disc harrowing two days before drilling (March 24th). Fifty foot-rows of drill track were marked out on the consolidated lines and fifty between them, all suitably randomised, and the following is a summary of the records obtained thereon :

	Consolidated by Tractor wheels.		Not consolidated.
May 5th ..	13.4	Plants per foot	13.31
May 13th ..	31.65	Tillers per foot	15.03
May 26th ..	42.85	ditto	25.17
June 10th ..	40.67	ditto	25.85
July 13th ..	32.15	Ears per foot	20.12
May 13th ..	43 lbs.	Consolidation	27.5 lbs.
June 18th ..	74 lbs.	ditto	45 lbs.
Grain .. ..	21.86	grammes per foot	12.66
Straw .. ..	23.14	ditto	13.15
GRAIN .. ..	28.42	CWTS. PER ACRE	16.42
STRAW .. ..	30	ditto	17.02

These differences in yield are significant. A representative sample of plants from each treatment was examined during the third week of May, and it was seen that nearly every one on the non-consolidated foot-rows had much longer epicotyls than the consolidated ones. Similar lines across the field were also noticed, which were caused by the tractor wheels when pulling the drill, and they were studied in the same way. The increased consolidation along the lines was evident when measured and, although the tiller counts and yields were slightly higher than on the non-consolidated parts, they were not significant. Records have been kept of the rainfall and state of the soil, and these will be studied in relation to the results.

Consolidation has been studied inch by inch downwards to depths of six inches on all the experimental plots with the compactometer. Moreover, the effects of rolling with ordinary farm rollers on the lower layers have been investigated by means of rubber bags filled with water buried at different depths, connected by piping to vertical glass tubes. It appears that the flat farm roller has little or no effects below the immediate surface layers.

## DUNN'S DRILL.

An acre on Field III was prepared and sown with barley at the rate of  $1\frac{1}{2}$  bushels per acre with the Dunn machines and under the inventor's supervision. Three  $\frac{1}{4}$ th acre plots were harvested from the acre and the mean yield was :

Grain ..	17.14 cwts. per acre.
Straw ..	14.54 cwts. per acre.

## "POCKET" SOWING.

A small observation plot was sown with barley in the spring, the grain being placed in consolidated depressions, or "pockets," three inches in diameter, half-inch

deep and ten inches from centres. This plot was sown three times but was damaged by birds upon each occasion.

#### DRILL TESTS.

The critical laboratory and field tests of cereal drills mentioned in the last report have been completed and the results have been published (*Jour. S.E. Agric. Coll.*, 28, 1931, page 286). The superiority of the force-feed type over the cup-feed was established.

#### SOIL COMPACTOMETER.

This instrument to measure soil consolidation has been modified, enabling readings of over 100 lbs. to be taken. Readings as high as this occur, even on cultivated soil, during dry periods.

#### PENETRABILITY OF POINTS.

The penetrability of sixteen different shaped steel points into soils has been studied with the aid of the compactometer. The work done has been published (*Jour. S.E. Agric. Coll.*, 28, 1931, pp. 237-242). This work is being continued.

#### MOLE DRAINING.

A demonstration of mole draining implements and machines was held, in conjunction with the Ministry of Agriculture, on Pilrags during February. This field was not entirely suitable for the work, but much information was obtained. An improved method of connecting minor with main moles was employed. Reprints of an article on Mole Draining (published *Jour. S.E. Agric. Coll.*, 28, 1931, pp. 296-299) are available for farmers and others. Two lectures to farmers have been given in Surrey on this subject.

#### TRANSPLANTER.

A demonstration of an improved model of the transplanting machine was arranged on Pond Field, when a cruciferous crop was handled. At one period the machine planted at the rate of approximately 7,000 per hour. Hand dibbers at the same time worked at the rate of 600 per hour. Some difficulty is still experienced by the feeders, two boys, in keeping pace with the feed band. There is undoubtedly a future for this type of machine.

#### RIDGING CEREALS.

A small observation plot of barley on Field C was ridged between the drill rows on May 13th, and on June 4th half of this was ridged a second time. These are the results obtained :

	No. Tillers per foot.	Length. ins.	No. Grains per ears.	Weight of grain per foot, gms.
Unridged .. ..	28.13	27.15	25.3	20.9
Once ridged .. ..	35.1	29.95	25.73	24.48
Twice ridged .. ..	35.51	29.03	25.03	22.92

These have not been statistically examined.

## ADVISORY WORK.

Enquiries for advice on mechanical problems have been dealt with throughout the year, and have been about as numerous as usual.

## PUBLICATIONS.

DAVIES, C., July, 1931. Improvements in the Soil Compactometer and Notes on its Performance. *Jour. S.E. Agric. Coll.*, No. 28, pp. 237-242.

*Idem.* A Comparison of Cup-feed and Force-feed Cereal Drills. *Jour. S.E. Agric. Coll.*, No. 28, pp. 243-266.

*Idem.* The Experimental Work of the Department of Engineering. *Jour. S.E. Agric. Coll.*, No. 28, pp. 284-287.

*Idem.* Mole Draining. *Jour. S.E. Agric. Coll.*, No. 28, pp. 296-299.

## DEPARTMENT OF ZOOLOGY AND GEOLOGY

By S. G. BRADE-BIRKS and BASIL S. FURNEAUX.

IN addition to the teaching work of the Department some advance has been made during the year with soil studies and several papers have been published. Before Mr. B. S. Furneaux, M.Sc., took over his duties in the Research Department of Chemistry in connection with the Fruit Soils Survey, the area mapped by the Department in the previous session was extended beyond the College Farms; in this work Mr. F. A. Pearson co-operated. This survey has not been published. Mr. J. Low, M.Sc., who is studying soils in Somersetshire and in the Wirral of Cheshire under the direction of the Head of this Department, has made satisfactory progress and has published a paper on some of the Somersetshire soils. Preliminary studies made by the Department in the past having promised some success from the application of soil profile methods to a correlation and classification of the soils of Romney Marsh and neighbourhood, work has been initiated by a team of workers: Messrs. L. W. Cole, B.Sc., J. K. Dubey, M.Sc. and R. M. Harrison, B.Sc., under the direction of Dr. Brade-Birks; with the addition of Mr. I. B. Prowse, B.Sc., this team forms a Committee under the chairmanship of Dr. Brade-Birks and in it Mr. Cole is making special study of chemical and physical factors, Mr. Dubey of the soil-profiles and Mr. Harrison of the herbage. Although the work is still in too early a stage for detailed report the examinations already made promise well.

The Head of the Department has again acted as Editor of the *College Journal* and especially in this capacity was able to co-operate with Professor Linwood L. Lee in the preparation of an important memoir for the last *College Journal* on the classification of soils. It is hoped to issue this memoir as a bulletin of this Department in the near future.

### PUBLICATIONS.

- (1) BRADE-BIRKS, S. G., July 11th, 1931. The Nomenclature of Soil Classification. *Jour. S.E. Agric. Coll.*, No. 28, 1931, pp. 115-116.
- (2) BRADE-BIRKS, S. G., July 11th, 1931. The Need for International Rules of Pedological Nomenclature. *Jour. S.E. Agric. Coll.*, No. 28, 1931, p. 127.
- (3) FURNEAUX, BASIL S., July 11th, 1931. Field Experience with the American System of Soil-Surveying. *Jour. S.E. Agric. Coll.*, No. 28, 1931, pp. 117-122.
- (4) LEE, LINWOOD L., July 11th, 1931. The Possibilities of an International System for the Classification of Soils. *Jour. S.E. Agric. Coll.*, No. 28, 1931, pp. 65-114.
- (5) LOW, A. J., July 11th, 1931. Soil Profiles in Somerset. *Jour. S.E. Agric. Coll.*, No. 28, 1931, pp. 123-126.
- (6) SANDS, N. H., July 11th, 1931. Results of a Small Soil Survey. *Jour. S.E. Agric. Coll.*, No. 28, 1931, p. 308.

## INDEX

- Abortion, Contagious, 40  
*Acidia heraclei*, 8  
 Agricultural Department, 46  
     — Publications from the, 52  
*Amphorophora cosmopolitana*, 8  
*Anthonomus cinctus*, 8  
     — *pomorum*, 8  
     — *rubi*, 8, 9  
*Anuraphis padi*, 8  
     — *roseus*, 8  
     — *subterranea*, 8  
*Aphis grossulariae*, 8  
     — *rumicis*, 7  
 Apple, *Fusarium* bud-rot of, 16  
     — Pests of, 8, 12, 13  
     — Scab, 16, 19, 28  
     — *Stevium purpureum* on, 16  
     — Varieties of, 54  
 Asparagus, Fungi attacking, 16  
*Atomaria linearis*, 7  
 Austin, M. D., Publications by, 14  
     — and Jary, S. G.: Department of Entomology, 7  
  
 Barkworth, H.: Dairy Bacteriological Advisory Service, 42  
     — Publications by, 45  
 Barley drilling, 57  
     — Effect of Soil Cultivation on, 55  
     — Consolidation on, 57  
     — *Helminthosporium* on, 16  
     — manuring, 46, 55  
     — Pests of, 7  
     — ridging, 58  
 Bean pests, 7, 8  
 Beet pests, 7  
     — Sugar, Manuring of, 47  
 Bescoby, H. B., Vickers, V. R. S., Fishwick, V. C. and Tinley, N. L.: Agricultural Department, 46  
 Blackberry, Crown Gall on, 15  
     — Pests on, 8  
 Bordeaux mixture, Chemistry of, 32  
 Botanical Department, 53  
     — Publications from, 54  
*Botrytis cinerea*, 21  
 Brade-Birks, S. G. and Furneaux, B. S.: Department of Zoology and Geology, 60  
     — Publications by, 60  
*Brassicæ*, Pests of, 7, 9  
 Burgess, A. H.: Hop Research Scheme, 25  
     — Publications by, 24, 26  
*Byturus tomentosus*, 8  
  
*Calandra granaria*, 10  
*Calocoris norvegicus*, 9, 13  
*Capitophorus ribis*, 8  
 Capsid Bugs, 10, 12  
     — on Apple, 8, 9, 12  
     — on Currant, 8, 12, 32  
     — on Hop, 9, 13  
     — on Potato, 13  
 Carnation Fly, 9  
  
 Carrot Fly, 8  
 Celery Fly, 8  
 Cereals, Pests of, 7  
 Chandra, P. P., Publication by, 54  
*Cheimatobia brumata*, 32  
 Chemistry Department, 13, 27, 31  
     — Publications from the, 30, 34  
 Cherry, Brown Rot of, 16  
     — Fruit-spot, 17  
*Chlorops taeniopus*, 7  
 Chlorosis of Hops, Infectious, 20  
*Chortophila brassicæ*, 8  
 Chrysanthemum, Capsid damaging, 13  
     — Crown Gall, 15  
*Chrysanthemum cinerariaefolium*, 10  
 Cockchafer, 8  
 Codlin Moth, 8  
 Compactometer, 58  
 Conference, Hop-growers', 15, 24  
     — Power Farming, 55  
     — Wye Provincial, 11, 15, 33, 54  
 Consolidation, Soil, Effect of, on Barley, 57  
 Contagious abortion, 40  
 Committee, Research, Members of, 3  
 Costs, Farming, 35  
 Cows, Abortion in, 40  
     — Food recording of, 36  
 Crane Flies, 8, 9  
 Crown Gall, 15  
 Cultivation experiments, 55  
 Cyanamide on grassland, 53  
 Cyclamen eelworm, 8  
*Cydia pomonella*, 8  
  
*Dactylum dendroides*, 22  
 Dairy Bacteriology, 42  
     — Publications on, 45  
     — Cows, Food recording of, 36  
 Davies, Cornelius: Engineering Department, 55  
     — Publications by, 59  
 Draining, Mole, 58  
 Drills, Seed, 57, 58  
 Duffield, C. A. W., 7  
 Dunn's Drill, 57  
  
 Earwigs, 8  
 Economics, Department of, 35  
     — Publications from the, 37  
 Editorial, 6  
 Elm Disease, 16  
 Engineering Department, 55  
     — Publications from, 59  
 Entomology, Department of, 7  
     — Publications from, 11, 14  
*Eriosoma lanigerum*, 8  
  
 Farms, College, Financial results on, 36  
 Fielding, W. L.: Publication by, 54  
 Fishwick, V. C., Vickers, V. R. S., Bescoby, H. B. and Tinley, N. L.: Agricultural Department, 46  
     — Publications by, 52  
*Forficula auricularia*, 8

- Frankliniella robusta*, 7  
 Frit-fly, 7  
 Fruit, Pests of, 8  
     — Soils Survey, 28, 60  
 Fungicides, 21, 27, 28, 31  
 Furneaux, B. S., 28  
     — Publications by, 30, 60  
     — and Brade-Birks, S. G.: Department of Zoology and Geology, 60  
*Fusicladium cerasi*, 17  
  
 "Gangrene" in sheep, 39  
 Geology and Zoology, Department of, 60  
     — Publications from, 60  
 Glasshouse, Pests in, 8  
 Goodwin, W.: Chemistry Department, 27  
 Gout Fly, 7  
 Grain Weevil, 10  
*Graphium ulmi*, 16  
 Grassland, Cyanamide on, 53  
     — manuring, 48, 53  
     — seed mixtures, 48, 53  
     — Yellow Rattle in, 53  
 Green, N. K.: Publication by, 54  
  
*Hadena oleracea*, 8  
 Harrison, R. M., Parkinson, S. T. and Pearl, R. T.: Botanical Department, 53  
     — Publication by, 54  
*Helminthosporium teres*, 16  
*Heterodera radiculicola*, 8  
     — *schachtii*, 7  
*Heterosporium Allii*, 17  
 Hewison, N. V., Publication by, 37  
 Hop Analyses, 23, 27  
     — *Aphis* on, 13, 22  
     — Canker, 21  
     — Capsid Bugs on, 9, 13  
     — Damson *Aphis*, 9  
     — Downy Mildew, 17, 25, 32  
     — Immunity in, 20  
     — Manuring, 25  
     — Mould, 20, 32  
     — New Varieties of, 23, 26  
     — Oast, New, 26  
     — Publications on the, 22, 24, 26  
     — Small, 17  
     — Spray injury to, 9, 18  
     — Virus diseases of, 20  
*Hydroecia micacea*, 7  
*Hylemyia brunnescens*, 9  
*Hylotoma rosae*, 9  
  
 Immunity in Hops, 20  
 Insecticides, 7, 10, 12, 13, 31  
  
 Jary, S. G., Publications by, 11  
     — and Austin, M. D.: Department of Entomology, 7  
 Jones, Gethin, 28  
  
 Knox, M. A., 37  
     — Publication by, 37  
  
 Lavender Blossom Wilt, 21  
 Leather Jackets, 7  
 Lee, Linwood L., Publication by, 60  
 Lettuce, *Marssonina* on, 17  
  
 Loganberry Beetle, 8  
     — Crown Gall on, 15  
 Low, A. J., Publication by, 60  
*Lygus pabulinus*, 8, 9, 12, 32  
     — *pratensis*, 12, 13  
  
 Machinery, 55  
*Mahonia*, Rust of, 16  
*Mamestra brassicae*, 9  
 Mangold, Effect of tilths on, 56  
     — growing, Financial results of, 35  
     — manuring, 47  
     — Pests of, 7  
 Manures, 27, 46, 47, 48, 53  
*Marssonina fragariae*, 17  
     — *panattoniana*, 17  
 Martin, H.: The Chemistry of Insecticides and Fungicides, 31  
     — Publications by, 34  
 McEwen, A. D.: Veterinary Department, 38  
     — Publications by, 41  
 Mechanised Farming, 55  
*Melolontha vulgaris*, 8  
 Meteorology, 53, 54  
 Middlings in pig rations, 51  
 Milk, Clean, 42  
     — Keeping quality of, 44  
     — Tainted, 43  
 Mixtures, Seed, 48  
 Moffatt, J. R., Publication by, 54  
 Mole draining, 58  
 Mushroom cultivation, 21  
     — diseases, 21  
     — pests, 8  
     — spawn, 21  
 Mycological Department, 15  
     — Publications from, 22  
*Mycogone perniciosa*, 21  
*Myzus persicae*, 13  
  
 Naphthols, 32  
 Nicotine, 13, 31, 32  
  
 Oats, Pests of, 7  
 Oils, Mineral, 31, 32  
     — Petroleum, 8, 12, 32  
     — Tar, 8, 12, 31, 32  
     — Vegetable, 12, 21, 32  
*Ohgonychus ulmi*, 8  
 Onions, *Heterosporium* on, 17  
*Oospora fimicola*, 21  
*Oscinis frit*, 7  
*Otiorrhynchus* spp., 8  
  
*Pachyrrhina* spp., 8  
 Paris Green, 7  
 Parkinson, S. T., Pearl, R. T. and Harrison, R. M.: Botanical Department, 53  
     — Publications by, 54  
 Parsnips, Aphid on, 8  
 Pasture investigations, 48  
 Pea Thrips, 7  
     — Weevils, 7  
 Pearl, R. T., Parkinson, S. T. and Harrison, R. M.: Botanical Department, 53  
 Pears, Pests of, 8, 13  
*Pegomyia betae*, 7

- Phellinus cryptarum*, 16  
 Phenological Garden, 54  
*Phorodon humuli*, 9  
*Phyllotreta* spp., 7, 8  
*Phytophthora infestans*, 13  
*Pieris* spp., 8  
 Pig husbandry, 49  
*Plectroscelus concinna*, 7, 8  
*Plestiocoris rugicollis*, 8, 12  
 "Pocket" sowing, 57  
*Polygonaceae*, Fragments of, in cattle cake, 53  
 Pomology, 54  
 Potato *Aphis*, 13  
 ——— Blight, 13  
 ——— Common Scab, 17  
 ——— Eelworm, 7  
 ——— Growing, Financial results of, 35  
 ——— Silver Scurf, 17  
 ——— Skin Spot, 17  
 ——— Stem-borer, 7  
 ——— Varieties, 46  
 ——— Virus diseases, 13  
 ——— Wart disease, 17  
 Powell, H. J. W., 37  
*Pseudoperonospora humuli*, 17  
*Psila rosae*, 8  
*Psylla mali*, 8  
*Psylliodes chrysocephala*, 8  
*Puccinia mirabilissima*, 16  
*Pyrethrum*, 10, 33  
  
 Raspberry Beetle, 8  
 ——— Weevil, 8  
*Rhizoctonia*, 16  
*Rhynchites coeruleus*, 8  
 Roberts, R. S., Publications by, 41  
 Romney Marsh soils, 60  
 Root crops, Financial results from, 35  
 Rose Sawfly, 9  
  
 Salmon, E. S.: Hops, 23  
 ——— Publications by, 22, 24  
 ——— and Ware, W. M.: Mycological  
     Department, 15  
 Sands, N. H., Publication by, 60  
 Sathe, V. V., Publication by, 54  
 Seed mixtures, Grass, 48  
 Sheep breeding, 35, 36  
 ——— feeding, 35, 36, 49  
 ——— "Gangrene" in, 39  
 ——— "Struck" disease in, 38  
 ——— Washing, Economy of, 48  
*Sitona* spp., 7  
 Soils, 27, 60  
 ——— Consolidation of, 57, 58  
 ——— Cultivation of, 55  
 ——— Fruit, Survey of, 28  
 ——— Publications on, 60  
 Sowing in "pockets," 57  
  
 Sows, Feeding and Management of, 49  
*Sphaerotheca humuli*, 20  
 Spider, Red, 8, 13  
 Spreaders, 32, 33  
 Staff, List of, 4  
 Strawberry, *Marssonina* on, 17  
 ——— Pests of, 8, 9  
 "Struck" disease of sheep, 38  
 Sugar beet manuring, 47  
 Sulphite lye, 32  
 Sulphur-shy fruit varieties, 32  
 Survey of Fruit Soils, 28  
*Synchytrium endobioticum*, 17  
  
*Tarsonemus fragariae*, 8  
 Thrips, 7  
 Tilths for Barley, 56  
 Timber, Fungus destroying, 16  
 Tinley, N. L., Vickers, V. R. S., Fishwick,  
     V. C. and Bescoby, H. B.: Agricul-  
     tural Department, 46  
 ——— Publication by, 52  
*Tipulidae*, 7, 9  
 Tomato Eelworm, 8  
 ——— Moth, 8  
 Transplanting machine, 58  
  
 Van Dyen's Test, 44  
*Vespa* spp., 8  
 Veterinary Department, 38  
 ——— Publications from the, 41  
 Vickers, V. R. S., Fishwick, V. C., Bescoby,  
     H. B. and Tinley, N. L.: Agricul-  
     tural Department, 46  
 Vine, Woolly Scale, 8  
  
 Ware, W. M.: Publications by, 22  
 ——— and Salmon, E. S.: Mycological  
     Department, 15  
 Wart Disease, 17  
 Wasps, 8  
 Weed survey, 54  
 Weevil, Grain, 10  
 Wheat, Growth of, 53  
 ——— meal for pigs, 50  
 ——— Precision records on, 53  
 ——— Top-dressing, 53  
 Willows, *Discella carbonacea* on, 16  
 Wool, 48  
 Wyllie, James: Department of Economics,  
     35  
 ——— Publications by, 37  
  
 Yellow Rattle, 53  
  
 Zinnia, Fungus parasitic on, 16  
 Zoology and Geology, Department of, 60  
 ——— Publications from, 60  
*Zopfia rhizophila*, 16



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